# Journal of the Society of Arts.

*FRIDAY, FEBRUARY 5, 1869.*


## Announcements by the Council.

### ORDINARY MEETINGS.

Wednesday Evenings at eight o'clock :—

FEBRUARY 10.—"On the Training and Education of Pauper Children." By G. C. T. BARTLEY, Esq.

FEBRUARY 17.—"On the Efficiency and Economy of a National Army in Connection with the Industry and Education of the People." By HENRY COLE, Esq., C.B. On this evening the Right Hon. T. MILNER GIBSON will take the chair. If necessary, the discussion will be continued on the following Friday morning, the 19th instant, at 11 a.m.

FEBRUARY 24. — "On Ventilation." By EDWARD SMITH, Esq., M.D., F.R.S.

MARCH 3.— "On the Adaptation and Extension of Present Means for the Promotion of Scientific Instruction." By H. H. SALES, Esq.

### CANTOR LECTURES.

A Course of Four Lectures, "On Painting," is now being delivered by S. A. HART, Esq., R.A., late Professor of Painting at the Royal Academy, as follows :—

LECTURE II.—MONDAY, FEBRUARY 8TH.

On the Practice of Portrait Painting.

LECTURE III.—MONDAY, FEBRUARY 15TH.

On the Suggestions offered by surrounding circumstances to the Artist.

LECTURE IV.—MONDAY, FEBRUARY 22ND.

On Landscape Painting.

Each lecture will begin at eight o'clock. These Lectures are open to Members, each of whom has the privilege of introducing two friends to each lecture. Tickets for this purpose have been forwarded to each member.

### FINAL EXAMINATIONS, 1869.

In order to avoid holding these Examinations on the same evenings as those of the Department of Science and Art, it has been decided to hold them, in 1869, on the evenings of

**TUESDAY, the 20th APRIL,**
**WEDNESDAY, the 21st ,,**
**THURSDAY, the 22nd ,,**
**FRIDAY, the 23rd ,,**

From 7 p.m. to 10 p.m., instead of on the 27th, 28th, 29th, and 30th April, as announced in the Programme of Examinations for 1869.

In consequence of this alteration the Previous Examinations must be held earlier, and the Forms No. 2 and No. 4, referred to in par. 6 of the Programme, must of course be sent in a week earlier than the dates there fixed for receiving them.

It is very important that this alteration should be made as public as possible. For this purpose a number of small slips, to be inserted between pages 8 and 9 of every Programme sent out, have been forwarded to each Institution and Local Board. Large bills, to be suspended on the walls of the Institution reading-room, or in some other public place, will also be sent on application.

In reference to the subjects referred to in the notice at page 9 of the Programme, a sufficient number of applications from candidates in Conic Sections, Navigation and Nautical Astronomy, and Mining and Metallurgy, have already been received. Papers will therefore be set in these subjects.

Candidates desiring to be examined in Italian should communicate their wishes without delay.

### ELEMENTARY EXAMINATIONS, 1869.

Secretaries of District Unions and Local Boards desiring to adopt the Society's scheme of Elementary Examinations, are reminded that they must apply to the Secretary of the Society of Arts before the 10th of February, stating the number of male and female Candidates respectively desiring to be examined in each grade.

### COMMITTEE ON INDIA.

The Council have resolved that a Committee be formed "to organize meetings for the discussion of subjects connected with the Arts, Manufactures, and Commerce of our Indian Empire."

The following gentlemen have been already invited to serve on this Committee:—

Archibald Campbell.
George Campbell.
Edwin Chadwick, C.B., Member of Council of Society of Arts.
Hyde Clarke, Member of Council of Society of Arts.
Sir Daniel Cooper, Bart., Member of Council of Society of Arts.
Sir William Denison.
Maj.-Gen. Sir Vincent Eyre, C.B., Member of Council of Society of Arts.
C. H. Fielder.
W. S. Fitzwilliam.
George Moffatt.
Sir Robert Montgomery, K.C.B., Vice-President of the Society of Arts.
Colonel Sykes, M.P.
Captain Edward Thackeray.
Sir Charles Trevelyan, K.C.B.
Dr. J. Forbes Watson.

In addition to these gentlemen, the East India Association has been requested to nominate three of its members to join the Committee.

The Secretary of the Society of Arts will be glad to receive the names of any members of the Society taking an interest in Indian questions, in order that they may be invited to attend the meetings above referred to.

### INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Belfast, Union-place Science School.

### SUBSCRIPTIONS.

The Christmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

## Proceedings of the Society.

### FOOD COMMITTEE.

A meeting of the Committee took place at the Society's House, on Wednesday afternoon, 13th January. Present—Mr. BENJ. SHAW (in the chair), Mr. G. F. Wilson, F.R.S., Mr. H. Michael, Rev. J. E. Hall, and Mr. J. A. Youl.

Mr. HARDWICKE, of 192, Piccadilly, attended for the purpose of informing the Committee as to the results of Professor Gamgee's process of preserving meat in accordance with the patents taken out by him before leaving this country for America. Professor Gamgee's process is thus described in his patents:—"The animals whose flesh is to be preserved are, when this is possible, killed by causing them to inhale carbonic oxide gas, which may be generated by the action of heat on a mixture of sulphuric and oxalic acids, or of sulphuric acid and ferrocyanide of potassium, or by any other method which yields carbonic oxide gas. The animals are then bled and dressed in the usual way, and the flesh may then be sold as human food, and even if it has travelled any distance it will retain a fresh and bright appearance longer than ordinary killed meat. The flesh of animals slaughtered with the aid of carbonic oxide gas or of animals slaughtered in the usual way may further be preserved as follows:—Firstly, by being placed in a closed chamber or vessel containing carbonic oxide gas alone, or a mixture of carbonic oxide and air or other gas or vapour for a period varying from two to twenty-four hours with a view to a complete action on the meat and its juices. Secondly, by simple fumigation of the entire carcase or portions of the carcase, after the action of carbonic oxide, by means of sulphurous acid gas alone or in combination with hydrochloric acid gas."

Previously to the meeting of the Committee, a piece of beef and some mutton chops, portions of the meat sent from America by Professor Gamgee, prepared by his process, having been cooked, were tasted by the members of the Committee present.

Mr. HARDWICKE now informed the Committee that on the 4th December, 1868, Professor Gamgee, having had the animals killed in the manner described above, caused a large air-tight tank to be filled with two quarters of beef, two hams, eight sheep, and a large hog, when they were subjected to his process. This was done in New York. On the 12th the tank was opened, and the meat removed from it. On the 16th the carcases of four sheep (whole), a quarter of beef, and half a hog, were wrapped in cloth separately, put into one large, rough packing-case, and forwarded to England by the Royal Mail-ship *Cuba*. It arrived in Liverpool on 29th of December, whence it was despatched by the London and North Western Railway to Mrs. Gamgee, at Bayswater, arriving there on the 30th December. The meat exhibited before the Committee that day was part of that so sent, and was preserved in accordance with Professor Gamgee's patented process. Mr. Hardwicke added that a letter he had received from Professor Gamgee informed him that the cost of preserving the carcase of a bullock was from 2s. to 3s.; that two men could preserve as many carcases as fifty men could slaughter; and that the cost of apparatus to slaughter and preserve one hundred bullocks per day would not exceed £10,000. The cost of conveyance of the package of meat referred to, which weighed about 400lbs., was stated to be £2 7s. 6d., which was accounted for by its being brought by a mail steamer, the freight of which was much higher than that ordinarily charged by trading ships. Professor Gamgee believed, from inquiries he had made, that the cost of transit would be considerably under a halfpenny per lb. With reference to the prime cost of the meat, of the quality of that sent from New York, Mr. Hardwicke said it probably cost within a 1d. per lb. in that city of what it could be bought for in this country; but, he added, in the event of the process succeeding, the supply of meat would be obtained from much cheaper markets. He was informed, he said, that in Kansas a bullock in condition for killing could be purchased for £1, and to that had to be added the 3s. for curing and the cost of conveyance to this country. That would enable the meat to be sold at 3d. or 4d. per lb. here, and leave a good margin of profit to the adventurers.

Mr. MICHAEL observed, that working out the £10,000 capital for setting up an establishment of the capacity stated, the cost would be 3s. 4d. for slaughtering and preserving a carcase of beef. That would leave 6 per cent. for interest and depreciation. On the general question as to the probability of the meat reaching this country in such a condition that people would eat it, and also on the commercial prospects of the matter, Mr. Hardwicke had expressed a favourable opinion, and a desire to see the experiment carried out on a sufficiently large scale to test the success of the process both scientifically and commercially.

The Committee recorded their opinion that the beef and mutton produced that day was untainted and well preserved. Some members detected an acid taste in the beef, and others noticed nothing peculiar. The mutton was pronounced to be slightly flat. It was, however, the opinion of the Committee, that the mutton exhibited was of inferior quality of meat.

Mr. ALEXANDER F. BAILLIE attended, and gave information relative to a proposal to import live cattle from the River Plate.

### CANTOR LECTURES.

The first lecture of the course by Mr. S. A. Hart, R.A., "On Painting," was delivered on Monday evening, the 1st inst., the subject being "The History of Portrait Painting." An outline of these lectures will appear in the *Journal* at an early opportunity.

### NINTH ORDINARY MEETING.

Wednesday, February 3rd, 1869; CHARLES TOMLINSON, Esq., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Anderson, John, 11, Carnmoney-street, Belfast.
Edwards, Henry Arthur, 132, Upper Thames-street, E.C.
Hunt, Charles, the London Gas Light Company, Nine Elms.

The following candidates were balloted for, and duly elected members of the Society:—

Alabone, Edwin George, Earlswood-house, Hackney, N.E.
Barrow, Captain Robert Knapp, Naval and Military Club, Piccadilly, W.
Clare, Walter Frederic, 16, Trafalgar-road, Old Kent-road, S.E.
Davison, William, 1, Lupton-villas, Tufnell-park-rd., N.
Dipnall, Mathias, S.S., Christ's Hospital, E.C.
Jones, Robert, Manor-house, St. John's.wood-pk., N.W.
Proctor, George James, Newport, Isle of Wight.
Smith, John Whittet, Elvet-house, Clapham-common, S.W.
Stone, John Benjamin, F.G.S., Union Glass Works, Dartmouth-street, Birmingham.
Walker, Lieut.-Col. W. L., 84, Inverness-terrace, W.
Wright, Henry Edward, St. Mary's National School, East Greenwich, S.E.

The Paper read was—

## ON THE USEFUL APPLICATION OF WASTE PRODUCTS AND UNDEVELOPED SUBSTANCES.

By P. L. SIMMONDS, Esq., F.S.S., &c.

About fifteen years ago, in a paper read before the Society, I threw out various suggestions as to the useful applications of "Some Unappreciated and Unused Articles of Raw Produce from different parts of the World,"* for which the Council did me the honour to vote me their silver medal. Just ten years ago, I again called the attention of the members to the "Utilisation of Waste Substances."† These notes I afterwards amplified into a popular volume, published under the title of "Waste Products and Undeveloped Substances," which passed through a large edition, and is now out of print. From the very many interesting papers that have since been read before the Society on the utilisation of other waste substances, and knowing from personal experience, and a close investigation at the different International Exhibitions with which I have been officially connected, that many of these hints and suggestions have developed themselves into important industries, I have thought that a short notice of the application and progress made with some of these formerly waste products might not be without interest.

I am aware that there is a kind of contradiction of terms in the expression of the utilisation of waste, since by the utilisation of all residuary matters there will be no waste in any manufacturing operations. There are many natural products, however, yet lying waste or undeveloped, to which attention will one day be prominently turned, as new demands arise to be supplied. My desire is to press upon the attention of all persons engaged in the useful arts the importance of the prevention of waste, and I shall advert briefly to the utilisation of the refuse products of certain manufactures and processes of domestic economy, with the hope of suggesting to those engaged in other trades the profits which might accrue to themselves, and the benefits which would result to mankind, from the useful application of these hitherto worthless residues.

In our great textile industries all the residue and nominal waste is pretty generally utilised; the waste from the cotton, woollen, and silk manufactures is all fully appreciated. Thus we import some 25,000 to 30,000 cwts. of silk waste to be used up. There are at least 60,000 tons of cotton waste in the cotton manufacture, which, added to 20,000 tons of linen waste, and the same quantity from rope and canvas, gives a large total to be worked up again for various purposes.

The enormous increased production of wool in the last ten or fifteen years has somewhat lowered prices, but has not done away yet with the using up of shoddy or re-converted woollen rags. Besides the large quantity of shoddy and mungo produced at home, we import 22,000,000 pounds of woollen rags, torn up to be used as wool. The use of shoddy in the last fifteen years has assumed gigantic proportions.

It has been well observed that the combination of shoddy with wool, together with the use of cotton warps, is the most valuable adaptation of materials in the history of the woollen trade which the ingenuity of man has discovered. By it multitudes of the humbler classes are enabled to obtain useful and comfortable articles of clothing, which formerly were beyond their means. Nor does it stop here. An immense mass of material, once thought all but valueless, has been rescued from the manure-heap, and made subservient to the wealth, industry, and comfort of millions. A feeling of prejudice or a smile of ridicule may rise at the thought, but manufacturers and consumers owe more to it than they are ready to admit. The manufacturers of pure wool goods are deeply indebted to it, for it has allowed them a full supply, which they could not have had, except at ruinous prices.

It often happens that the value of a thing is only discovered after its loss. Stop the supply of shoddy, and you may reasonably expect to double the present price of wool, and deprive millions of their warm and cheap winter garments, and their light and useful summer ones. Stop the supply of shoddy, and you will close one-third of the woollen mills in the kingdom, and bring distress upon the West Riding of Yorkshire.

In all civilised and densely-populated countries, of the animals used for the food of man, it may be said that nothing is wasted, every part that is not eaten being turned to some useful purpose; the refuse fat is converted into tallow or soap, the greater portion of the skin is made into leather, and the scraps, with the hoofs, feet, and various membranes, converted into glue, the horns made into various useful articles, and the bones produce phosphorus and manure.

When, in 1854, I drew the attention of the Society to the large quantities of animal food wasted in Australia and the River Plate districts, the subject of increased animal food supplies for our home population had not reached the importance it now possesses. The inquiries set on foot by the Food Committee of the Society have resulted in the publication of much useful information. The British people eat more meat than any other nation; and with the progress of industry, and the larger accumulation of population in towns, we find our home supply is not sufficient, while prices continue to advance. Naturally, then, we turn to those great pastoral countries where meat is a drug, and numerous endeavours are being made, with more or less success, to place within the reach of the meat-consuming people here the good beef and mutton of Australia and the River Plate.

Take the great empire of Russia—what an enormous waste of good animal food is there met with, owing to the difficulty of bringing it to a profitable market—with 20 million horses, 30 million head of cattle, and 60 million sheep, besides 10 or 12 million head of swine, the 60 millions of population can not only be well fed, but have a large surplus available, which is only rendered into tallow. The production of tallow annually is stated to be about 200,000 tons, of which half is consumed locally. The average price of meat in Russia is four copecks, or a penny per pound. Not only the fat and the bones, but frequently the entire carcase, is thrown into the melting-pot for tallow.

It is certainly tantalising to many hungry mouths, who find meat an expensive necessary here, to know that the South American States have 70 millions of sheep and 22 millions of cattle, which they scarcely know what to do with, except for their skins and tallow; while there are in the Australian colonies four million cattle and nearly 40 million sheep. It is true that, failing in the transport of some of this surplus here, strong efforts are making to draw population to those productive regions,

* See *Journal*, vol. iii., p. 33.
† See *Journal*, vol. vii., p. 175.

where numerous advantages are held out to immigrants. Still, our home production of animal food is not likely to keep pace in the United Kingdom with the growth of population. Nine millions of cattle, and 35 millions of sheep, do not suffice for our 25 millions of people, and compare rather unfavourably with the enormous numbers in more extended but less densely populated pastoral districts.

Unfortunately, in this instance, distance does not lend enchantment to the view, and commercial and scientific men are striving what can best be done towards bringing the surplus food here alive or dead. The cooked meat does not find general favour, and the modes of preparing raw meat at present in use are scarcely less satisfactory. Whether the reward offered by the Argentine Republic will lead to the adoption of any new improved process remains to be seen. Several screw vessels are, I believe, being specially fitted out to bring over cattle alive from the River Plate; but those who have had experience in the cattle traffic, from much shorter distances, will, I think, agree with me that the profitable results for so long a voyage are very doubtful, looking at the difficulties of supplying water and fodder, even after the cattle have been driven from long distances to the port of embarkation.

Horned stock has increased of late in Australia in a more rapid ratio than the population, and the consequence is that the supply of beef being greater than the demand, a market has to be found for the surplus in other parts of the world. The price of cattle is already commonly quoted "at boiling rate," in other words, fat cattle will fetch no more from the butchers than can be realized from their hides, horns, hoofs, tallow, &c., for exportation. Under the old and slovenly system of sending cattle to the melting-pot, it is certain that from one-fourth to one-half of what ought to have been profitably turned to account was wasted. The value of cattle and sheep must in future be measured in the colonies not by the local demand for butchers' meat, but by the price which can be obtained for the various constituents of the carcase in the markets of the world. The utilisation of this waste animal food has received a large share of attention in the past two years from various Australian companies established to prepare animal food in different forms, whether as extract of meat, tinned provisions, or dried and smoked meat.

A new use for a formerly waste substance is the legalised employment of horse flesh for food in France. The Society has already drawn attention to this matter, but horse flesh as human food is not likely to find much favour in this meat consuming nation, where even the very poorest classes are the most dainty in their requirements.

The Prefect of Police of Paris, in June, 1866, issued an ordinance recognising and regulating the use of horseflesh for human food. Considering (says the document) that the flesh of the horse has been introduced into consumption in several countries without apparent harm, the sale of horse meat as food is permitted on the following conditions:—That special slaughterhouses be established; that no meat be sold by the ordinary horse slaughterers; that the animals whose flesh is to be eaten be killed in the presence of a veterinary inspector; that the pieces shall be stamped; all unhealthy horses are excluded; at every place where such meat is sold the fact must be indicated by a placard; all restaurateurs or others who make use of horseflesh shall be compelled, under penalties, to inform their customers of the fact. The consumption of horseflesh as food appears to be largely on the increase in Paris. An official return lately published shows that the consignment of salted horse to the capital from the department du Nord amounts to nearly 30,000 pounds weekly.

I pointed out in a former paper that more attention was being given to the waste products of the fisheries; but in this industry enormous progress has been made. Every description of fish is useful for some purpose or other, and very many, such as the dog fish and others, which were formerly thrown away, are now largely used as food on the Continent.

The shark fishery is carried on in many parts of the Indian Ocean and on the eastern coast of Africa, but lately it has been pursued on the coast of Norway. About Kurrachee, in India, as many as 40,000 sharks are taken in the year. The back fins are much esteemed as a food delicacy in China, from 7,000 to 10,000 cwt. of these being shipped annually from Bombay to China. There are two kinds, known as white and black fins, which appear to be chiefly obtained from *Rynocobatus pectinata*, *R. laevis*, and *Galiocorda tigrina*. White fins fetch 60s. the maund, black fins only 18s. When the fish are landed, the back fins, the only ones used, are cut off and dried in the sun on the sand; the flesh is cut off in long strips and salted for food; the liver is taken out and boiled down for oil; the head, bones, and intestines left on the shore to rot, or thrown into the sea. The rough skin of some sharks is used by the native workmen for polishing wood and ivory, and is also made into shagreen.

The shark fishery affords very lucrative employment to the inhabitants of the northern districts of Norway, where it is carried on on an extensive scale, the four following species being met with: the Greenland shark *(Scymnus borealis)*, the basking shark *(Selache maximus)*, the picked dog fish *(Squalus acanthias)*, and *Squalus spinax niger*. The fishery is carried on in boats of 25 to 35 tons, with a crew of six men, and, anchoring on the banks, they fish with seal blubber. The Greenland shark varies from 10 to 18 feet, and the liver yields from one half to two barrels of oil. After taking out the liver, and inflating and tying up the fish again, it is thrown back, and floated away. When the fish can be towed to shore, the flesh is converted into food for the cattle, should the dried fish heads, on which they are usually fed, be scarce. It is also occasionally used as human food, being cut into long strips and dried in the open air, or buried in the ground until partially decomposed, when it is taken up and prepared in a peculiar manner. It requires, however, an Arctic stomach to digest it.

The basking shark is harpooned; its size varies from 30 to 35 feet. This shark usually renders from five to seven barrels of liver; occasionally as much as from 10 to 16. When the liver is rich, six barrels will yield five of oil, 30 gallons to the barrel. No other part of the fish is utilised.

The fishing for the dog-fish affords lucrative employment to the fishermen during the whole of the summer, from the Naze to the North Cape. This fish is sometimes eaten fresh, but must be skinned before being cooked. It is, however, mostly smoked, and in this way it is considered rather a delicacy. It is also dried as split stock fish for consumption in the country, as well as for export to Sweden, where it is greatly appreciated. The yolk of the egg, which is about the size of a pigeon's egg, is used by the inhabitants as a substitute for other eggs in their domestic economy. The skin is employed by joiners and turners for polishing purposes. The liver is exceedingly rich, and makes a very fine oil. The other dog-fish *(Squalus spinax niger)* is the smallest of the shark tribe. It is not eaten, but sought after exclusively for the liver, which is unusually rich, and yields a very superior oil.

I cannot but conceive that we are much too dainty in our choice of edible fish, much being rejected by the fishermen that would be wholesome and nourishing. The French are more thrifty in this respect. Notwithstanding the attention lately given to fish culture, our sea fisheries require to be largely developed. It is said that nearly a tenth of the population of China derive their means of support from the fisheries; and yet, with our sea littoral, how small is the proportion of persons who follow fishing as a business. At the recent Maritime Congress, held during the Havre Exhibition, one of the questions propounded was whether attention might not profitably be given by the French to the seal, tunny,

and shark fishery, as pursued so profitably on the Norwegian coast.

There are many fish oils that might yet be brought into use for commercial and medicinal purposes. For several years M. Gobley, of the Paris School of Pharmacy, has prepared an oil from the liver of the skate, which is much less nauseous to the taste and smell than cod-liver oil. Professor Owen has also pointed out the services that might be rendered to medicine by the livers of various sharks and dog-fish which are met with on our coasts, and especially in the tropical seas, which are rejected by fishermen. In India shark-liver oil is prepared in the ports of Mangalore and Tellichery, and at Nellore and Gantour in the Madras Presidency.

M. Collas, principal naval surgeon and chief of the service of health in the establishments of French India, in the *Revue Coloniale* for 1856, pointed out that he had found shark-liver oil equally as efficacious as cod-liver oil, especially as an internal remedy in the case of certain ulcers in the inferior limbs, common in tropical countries, and for which he had previously found no remedy. I fancy, however, that the shark-liver oil has such an offensive odour and unpleasant taste that no mechanical or chemical process will remove it.

Our colliery produce cannot last for ever at the enormous rate at which we are working the mines, and as the quantity of small waste coal per annum in the United Kingdom has been estimated at 28,000,000 tons, the utilisation of this refuse is a matter of national importance in more senses than one. Various, not very successful, attempts at making patent fuel have been attempted in this country. The idea of utilising the dust and waste of coal is neither new nor recent, yet so enormous are the quantities of this refuse that there is room for very many ways of profitably treating it. Very effective and valuable fuels have been so prepared by means of admixtures of tar, pitch, silicates, and other substances. About three years ago the United Kingdom Patent Fuel Company proposed to do great things in making bricks of coal dust with farina and alkali, but the cost of the manufacture did not permit the condensed fuel to compete with ordinary coal.

On the Continent and in the United States the manufacturing efforts have been more successful. In the coal mines of Charleroi, Belgium, 800,000 tons of coal dust have accumulated, impairing the working of the mines, and M. Dehaynin, of Paris, and a company are working on this coal dust. After having it pulverized and freed from all strange matter, by machinery, this dust receives the forms and dimensions the best adapted for heating locomotives, by agglomerating eight parts of coal tar with ninety-two parts of coal dust. This mixture, heated to 300 or 350 degrees, with superheated steam, becomes a paste, which is mechanically and powerfully pressed into cylindrical or rectangular forms, and after having been cooled, solid, compact cylinders, of about five inches diameter, and weighing eighteen pounds, or prismatic blocks of about five and a half inches by seven and twelve high, weighing twenty pounds, are obtained. These blocks are very nearly the same density and weight as the solid coal, and they burn without giving obstacle to the circulation of air through the grate. This new combustible is warranted not to give more than six per cent of ashes, and is now in great demand by railway companies, on account of its greater heating power, and its being actually cheaper than ordinary coal. M. Dehaynin and the company now manufacture annually, 255,000 tons of this agglomerate. In economising the waste coal of the collieries, this manufacture supplies railways and steam-boats with fuel of good quality and easy of stowage, and also utilizes the enormous quantities of tar resulting from the manufacture of coal gas. Lastly, it gives rise to an industry which obtains from this same tar other products of immense value. From a black, oily, and almost fetid material science now obtains a series of dyes and colours of surpassing brilliancy and freshness. Phenic acid, now employed in medicine and surgery, and benzine, &c., which is used for removing stains from stuffs, to dissolve india-rubber, in the making of varnishes, and for the preservation of timber, are amongst the valuable applications of coal tar. All these applications of waste material have been so ably described recently before the members, that it is quite unnecessary for me to refer to them at greater length.

Great use is made in France of various waste substances for lighting fires, such as the cones of pine trees. The Société des Allumettes Landaises, of Paris, does a large trade in the sale of waste cobs of maize, or Indian corn. These are first steeped in hot water containing 2 per cent. of saltpetre, and after being dried at a high temperature, are saturated with 50 per cent. of resinous matter. These lighters, which are sold at from 10s. to 16s. the thousand, are employed with advantage and economy in private houses and for lighting furnaces.

In France, much attention has been profitably given to the utilisation of bran, gluten, and artificial gums, such as dextrine, leicomme, gommeline, and other starchy and gummy products. Among other uses for the refuse from potato-starch is that for flouring or dusting their kneading troughs, &c., by bakers.

Much has been done in developing new substances for starch, but the enumeration would be too long here.

Improvements in technical chemistry have added largely to the number and value of its products. This branch is susceptible of almost unlimited extension and application, in the creation of commercial and useful articles from the refuse of every other manufacture and the diversified products, vegetable, animal, and mineral, of our own and other lands. Many of the chemical branches, apart from the money value of their manufactures, are of the highest economical importance to the country, as auxiliaries to almost every other industry of the people. Chemistry has as yet revealed but a tithe of the vast wealth of its resources.

I was much struck, at the recent Exhibitions at Paris and Havre, with the illustrations of the utilisation of waste greases, shown by Messrs. Souffrice and Co., of St. Denis. This old house was the first to employ, on an extensive scale, steam and hydraulic pressure for the extraction of fatty substances. In 1860 they first turned their attention to the pickings and waste from the slaughter-houses, and a return of 120,000 francs per annum was the result of their efforts. In the early part of 1863 they created a new industry for utilising the skimmings of the Seine. The Prefect of the Seine, considering the benefit that would arise to health by freeing the river from dead animals, floating grease, and other unwholesome matters, granted this house the exclusive privilege on the Seine for a small rent. In December, 1864, Messrs. Souffrice and Co. proposed to the Prefect to undertake the removal of all greasy waters, and the waste and pickings of vegetables, in the twenty-five hospitals of Paris belonging to l'Assistance Publique, which was accepted, and a concession granted for six years. This led to the formation of an extensive piggery on their works, one of the largest in France, having continually feeding 600 to 700 head of swine. The firm was the first to utilise these pickings of vegetables, when cooked by steam, for the fattening of pigs, and more than 3,000 fat pigs are annually sold, raised from this collected waste. In December, 1867, Messrs. Souffrice and Co. fitted up two distilling apparatuses, to work another industry that had not been before attempted. The black residues after purifying colza oil, called fecal acids, after distillation are turned out white, pure, and fit for the manufacture of soap. About 500,000 pounds of this substance are annually produced. In 1868 they conceived the idea of utilising the distilled tar, by combining it with turpentine and forming an excellent varnish, calculated to be useful to machinists and for ships, not only from its good quality, but its low price. 100,000 francs are paid yearly by the above firm to various railway companies for the old grease, called "cambouis," which has served for greasing the axles of the wheels of

the carriages. The purified products obtained are sold partly to the manufacturers of stearine, for saponification or for distillation.

From the residue of the manufacture is furnished, to farmers and cultivators, an excellent manure. The water in which flesh has been cooked, saturated with sulphuric acid and mixed with the urine of the pigs, is delivered gratis, about 50 hectolitres a day, to the cultivators of the sandy plains in the neighbourhood. With the pressed animal residue an excellent manure is made, to the extent of one million pounds a year, sold at 10s. the cwt.

Dr. Hofmann, in his Chemical Report (Exhibition 1862), tells us that bisulphide of carbon has been found by M. E. Deiss to be especially useful for recovering the oils retained by the pressure residue of olives, or by the sawdust through which the oils have been filtered to purify them; also for extracting the fatty matter contained in the spongy parts of the joints of beef and mutton bones, &c. M. Deiss has already established several large works in which fatty substances are extracted from residual matters by means of bisulphide of carbon, one at Paris, another at Brussels, a third in London. In these works about 8,000 kilogrammes (16,500 lbs.) of residues are treated daily, and the quantity of fatty substances diurnally recovered amounts to more than 1,300 lbs. The fatty bodies extracted by means of bisulphide of carbon have all the properties of those obtained by mechanical pressure; in some cases, however, they are, according to M. Deiss, somewhat richer in stearine. Thus the oil remaining after repeated pressure in olive oil-cake and extracted by bisulphide of carbon is decidedly richer in stearine than ordinary olive oil, and on that account is particularly adapted for the manufacture of soap. M. Deiss has, as yet, met with some difficulty in disposing of the exhausted oil-cakes as manure, but experiments, made on a large scale, have satisfied him that the bisulphide extracted cakes are not less efficacious than ordinary oil-cakes. To show the importance of the extraction of residues of fatty substances, it may be mentioned that according to M. Deiss's estimate the quantity of oil annually lost at Marseilles amounts to nearly seven million pounds, while in the departments of Calvados and Nord the loss is at least doubly as great.

Some years ago the committee of the London Ragged School set on foot a rag-collecting brigade, with a few trucks, to collect waste materials in the metropolis. Its necessity was suggested by the evidence given before a select Parliamentary Committee, in 1861, when it was stated "that not more than four-tenths of the rags of this country were preserved, and that if the remaining six-tenths could be returned to be re-manufactured, there would be no necessity to go to foreign markets for some twenty-five per cent. of the rags now required for the paper manufacture of England." And if this is true of so comparatively valuable a commodity as rags, must it not be also true to a much greater extent of less valuable but still most important articles in our commercial economy, such as waste paper, grease, bones, broken glass, rope, carpet, &c.? For instance, what becomes of the envelopes of the million letters passing daily through our London post-office? all of which are worth preserving. Mr. Lloyd, of the Bow Paper Mills, tells me that he purchases from twenty to thirty tons a week of old paper, such as old account books, old letters, invoices, envelopes, cheques, insurance policies, &c., paying £12 a ton for them. Quantities are sent him from the extremities of the kingdom, even from Edinburgh and Cornwall. Nowhere is the class of waste collectors so developed as in Paris, where the chiffonier forms a peculiar type almost unknown elsewhere.

Various attempts, which have been made from time to time, to introduce new raw materials for paper, have been attended with but partial success. The failure, according to Dr. Playfair, generally results from one or more of three causes:—

1. Some fibres require so much cost to bring them to the state in which they are offered to paper makers, in the form of rags or cotton waste, that in point of economy they cannot enter into competition with the latter.

2. Certain fibres lose so much weight in bringing them to this state, that they cease to be economical.

3. Certain fibres, which are well adapted on account of their texture for the paper trade, present so many difficulties in bleaching them, as to render them unfit for white paper.

Only three or four new waste substances have as yet come largely into use for the supply of the paper maker—straw, esparto fibre, wood pulp, and the bamboo. Straw, although largely utilised now for paper, I need say nothing about.

The enormous trade which has sprung up in the wild grass, known under the name of esparto, for paper making is an instance of the utilisation of a waste or neglected vegetable fibre. This coarse strong grass, growing in tufts, resembling in the cylindrical form of the stalk, rushes—the *Stipa tenacissima* of Linnæus—has only come into general commercial use in the last ten years. In 1851, specimens of the fibre and of paper made from it were shown in the Algerian department of the Exhibition, but our paper makers ridiculed it, until a dearth of rags drove them to look for some material which might be utilised. On the 28th of November, 1856, the number of the Society's *Journal* containing Dr. Forbes Royle's paper on Indian fibres, was printed on paper made from esparto, by Mr. T. Routledge. What do we now find?—that our imports of this wild grass for paper-making reach from 55,000 to 70,000 tons per annum, against 18,000 to 20,000 tons of foreign rags; the price, too, of this raw material is low, whilst its utility is shown by the fact that its use is very general, even the *Times* condescending to use paper with a blend of esparto in it. From the south of Spain alone the export of esparto reaches 50,000 tons per annum, at an average of £4 per ton, whilst from Algeria the exports are equally large. This extensive use of esparto has furthered the cause of literature by cheapening the raw material for paper, and supplied a want of which our shipowners had long complained—return cargoes from Spain and Algeria. To Mr. E. Lloyd, of the Bow paper-mills, much credit is due for his persevering enterprise in seeking out in its native localities and utilising so largely for his extensively circulated cheap weekly periodical this important paper material, and other unused vegetable substances.

Wood pulp for paper is now very largely employed. The suggestion of the applicability of wood fibre to paper-making is by no means new.

Early in 1826, the brothers Cappucino, paper-makers of Turin, discovered the means of supplying the want of rags by the fabrication of paper from the thin bark of the poplar, willow, and other kinds of wood. The Academy of Sciences having examined the specimens of writing, printing, and wrapping paper thus produced, acknowledged their goodness, and praised the inventor. The King granted the inventors an exclusive privilege for ten years for the manufacture of paper from ligneous materials.

In 1838, James Vincent Desgrand took out a patent in this country for making paper and pasteboard with wood, reduced into a state of paste, and of the different sorts of wood that came under the denomination of white woods, he found poplar answer the best. In 1855 William Johnson was granted a patent for improvements in the application of various substances containing woody fibre to the manufacture of white paper pulp, as the inner bass of the lime-tree and other *Tiliaceæ*, the willow, birch, and elder.

Particularly facetious persons have more than once informed us that sawdust is a highly nutritious article of diet when properly cooked; but uses have been found for it other than gastronomical, one being as a fibre for

paper-making. Wood of any kind or age is equally well adapted for this process, which is being extensively worked in some of the Continental States. At the London International Exhibition of 1862, Wurtemberg contributed several samples of paper made from wood-pulp mixed with rags, the proportion of the former varying from 10 to 80 per cent.; and the paper was reported to be serviceable, although of a low quality. The wood was simply rubbed down into pulp against the periphery of a wheel prepared with a rough face, so utilising the enormous waste of the timber-producing forests of the north of Europe. A good rule, equally applicable to the manures of the farmer and to the supply of the paper-making material, I would give in a few words:—Use what others waste. If the thousands of tons of sawdust annually wasted at the different saw-mills in America and Europe could be collected, there would be no want of material for paper of a certain quality. But as this cannot be done, we may fairly suppose that, in some localities, an abundant supply may be maintained; if not, resort must be had, provided that the wood itself is cheap enough, to mechanical means of disintegration.

Three or four years ago, the Americans went into the manufacture of paper from wood, the Manyunk Wood Pulp Works, Pennsylvania, being established on a large scale, capable of boiling 30,000 lbs. of pulp (when dry) every twenty-four hours. It may appear to the uninitiated that the expense of the enormous consumption of alkali involved in this process would be fatal to its commercial success; but, fortunately, no less than 85 per cent. of the alkali is recovered after every boiling, to be used over again with 15 per cent. of alkali on a new supply of wood. To recover the alkali, the liquor drained from the pulp is collected in drains under the floor of the boiling-house, and thence conducted by underground pipes to the evaporating-house, whence it flows through evaporating furnaces subject to heat both above and below.

There are now more than thirty paper mills in Germany working up wood pulp, and there is not a journal published there which does not contain more or less of wood pulp in the paper used. At the Paris Exhibition in 1867, was to be seen in action one of the large machines of 50-horse power, constructed by Decker, Brothers, and Company, working the process of Mr. Henry Voelter, of Heidenheim, Wurtemberg, for making wood pulp for paper. The exhibitor, who was the first to carry on the manufacture, has developed it on a large scale, and greatly reduced the price of all kinds of paper by introducing from thirty to sixty per cent. of wood pulp into the fabric. He also exhibited a very large collection of various kinds of paper made from wood. All white woods are available for this purpose.

The bamboo has long been considered one of the most useful grasses in the East, but it is only of late years that we have begun to turn it extensively and profitably to those purposes to which the Chinese had long applied it. Besides its other numberless uses, it is much employed for making common paper in China, and their touch paper is made by beating the young shoots flat, steeping them for some time in a lime pit and then washing and drying them. The silicious exterior is slit into strips for weaving ropes, baskets, mats, sieves, &c., and for cabinet work. The bamboo has been for some years exported from Jamaica to the United States in bales and bundles for making paper. The great bulk of the article, however, was an objection, until the stems were first crushed between horizontal rollers so as to make it more portable. In the close of 1865 the *New York Daily Tribune* was printed upon bamboo paper made by the Fibre Disintegrating Company, working at New Jersey, under a patented process of Mr. A. S. Lyman. The bamboo is subjected to high pressure in steam cylinders, which disintegrates the fibre and dissolves the silex. It is then boiled in waste or spent alkali in an open vessel, and afterwards purified and bleached in the ordinary manner in paper-making. The Fibre Disintegrating Company have large works at Red Hook, South Brooklyn, a factory at Elizabeth Port, New Jersey, and works at Carondelet, near St. Louis, Missouri. The company also make paper pulp from a species of wild cane which abounds on the banks of the Mississippi, also from hemp stalks. Not less than 100 tons of cane are roughly broken down daily to be sent to the paper mills. The price of the material delivered undried is said to be only £1 per ton, and the cost of disintegrating but 5s. per ton, whilst the yield is one ton of paper pulp to five tons of the undried cane. A variety of other substances have been tried, but few drawn into use for the manufacture of even the coarser kinds of paper; still, even for these, the raw material is in demand, and substitutes for the finer flax and hemp rags have been for some time much in request for the better kinds of writing paper. Dr. Mueller, of Victoria, at the request of the Secretary for the Colonies, has devoted attention to an investigation of the local substances adapted to paper making. I have specimens here of twenty-eight kinds of paper made by him in Australia without any addition of rags. Eleven of these are from barks, principally of the *Eucalypti*, most of which make good packing and printing papers. The best appears to be that of the stringy bark (*E. obliqua*), which makes a paper suited for packing, printing, and even writing, and which can be employed for mill and paste boards. The pulp bleaches readily, and this is considered the most important material drawn into use. The bark is extremely thick and pithy; it moreover separates with the utmost facility, and is universally used for thatching rural dwellings in the colony. The supply is available by millions of tons. The area within Victoria alone, wooded almost exclusively with stringy bark, must extend over many thousand square miles, generally as yet without any habitations. Allied trees, with thick fibrous bark, occur in West Australia, Queensland, and North Australia, though not so extensively. The bark yields readily to mechanical appliances on account of its lax and loose texture, and is also easily acted on by caustic soda for conversion into pulp. No pains were taken purposely to prepare a superior paper, but merely to bring into some form the paper fibres available. The other papers made from foliage of trees, from grasses, rushes, and allied plants are curious, but do not call for any special notice. A quarter of a century ago New Zealand flax was shipped in the form of square solid lumps, prepared as a paper material; but, although making a very strong paper, no commercial progress has been made with this material.

When, so far back as 1824, Professor Olmsted drew attention in the *American Journal of Science* (vol. 8, p. 294) to the utilisation of the cotton seed, he little foresaw what an important commerce would arise in its products. He then suggested that on account of its cheapness it might be employed in the manufacture of gas, in preference to coal, which was then a scarce and expensive article. Nearly three-fourths of the entire cotton crop consists of seed, and there cannot, therefore, be less in all the cotton growing countries than 1½ million tons of seed available. Formerly the seed accumulated in offensive and noxious piles about the cotton gins; now, cotton seed for planting in various countries, for oil for burning and eating, and the cake for cattle, are all largely in demand.

In the last five years, the import of cotton seed into Great Britain has been from 80,000 to 100,000 tons annually, all, with the exception of an insignificant portion, from Alexandria. It yields, by crushing, about 19 per cent. of crude oil, almost black, the residuum being cake for cattle food, value £7 15s. per ton. This oil is refined at an expense of about £5 per ton; and the present value of the refined oil is £30 per ton. It is similar in appearance to refined colza oil. An immense quantity was shipped last season to the South of France, for eating purposes, that is to say, as a substitute for olive oil, which was then scarce. The residue of the

crude oil after refining is distilled, and, with care, produces a hard grease or stearine, which commands, when produced of good colour, within 3s. or 4s. per cwt., the price of St. Petersburg tallow. Even the foots or tarry substance remaining, is useful as a paint ingredient. Sometimes the seed is decorticated before being crushed; this process does not alter the nature of the crude oil expressed, although it produces a finer oil-cake, now selling at £9 15s. per ton, and it is quite worth the difference of price, being almost free from the black, tough, indigestible husk.

The beetroot sugar manufacture on the Continent has now made such enormous strides that nearly one million tons are made annually. In the manufacture, two refuse substances are obtained, the expressed grated root, or sugar cake, and the molasses. The first constitutes hard solid cakes possessing considerable nutritive properties; it is therefore used with much advantage, along with other food, in the feeding of cattle. The molasses was formerly given to pigs, or used for making a soluble colouring matter, its value not having been appreciated as it deserved. It is now, however, generally applied as the raw material for the distillation of alcohol. When mixed with water slightly acidulated with sulphuric acid, and submitted to fermentation, the molasses will yield about 24 to 30 per cent. of pure spirit. This beet spirit is, I believe, largely used, like potato spirit, to adulterate brandy. In the watery liquid remaining in the stills are found all the salts originally contained in the juice of beet-root. Experience has shown that it repays well the cost attending the evaporation of the water to obtain these salts (almost entirely composed of compounds of potassium) in a dry form.

The large quantity of dye-woods remaining after the colouring matter has been extracted has hitherto been almost useless. In 1867, we imported 40,000 tons, and France and other countries also import equally large quantities. In France, however, the residue is mixed with tar refuse, and formed into compressed cakes for fuel. I was much struck with the extent of this utilisation at the large factory of Messrs. E. Dubosc and Co., of Havre. This firm now produces about 120 tons of agglomerated wood fuel per month. The product is distinguished by the relatively small quantity of coal-tar, 25 to 30 per cent., which they use, as well as by the low price at which they are able to sell it, as compared with other artificial wood fuel, namely, 4s. per cwt., at the works. The spent bark of our tanneries, submitted to a hydraulic press, might be applied with coal-dust as an economic fuel, and the derivatives by distillation usefully applied.

A new and curious application of a waste product is the utilisation of the acicular leaflets of pine trees. Near Breslau, in Silesia, are two establishments, one a factory where the pine leaves are converted into what is called "forest wool" or wadding; the other an establishment for invalids, where the waters used in the manufacture of this pine wool are employed as curative agents. The manufacture has extended, for there are now factories at Runda, in the Thuringer-wald, at Jonkoping, in Sweden, Wagenerger, in Holland, in parts of France, and other places. Two cases of these products were shown at the last Paris and Havre Exhibitions, which contained various illustrations in the shape of wool for stuffing mattresses and other articles of furniture instead of horse-hair, vegetable wadding, and hygienic flannel for medical application; essential oil for rheumatism and skin diseases, cloth made from the fibre, articles of dress, such as inner vests, drawers, hose, shirts, coverlets, chest preservers, &c., and other useful applications. In the preparation of the textile material an ethereal oil is produced, which is employed as a curative agent, for burning, and as a useful solvent. The liquid remaining from the decoction of the leaves is used for medical baths. The membranous substance and refuse are compressed into blocks and used as fuel; from the resinous matter they contain, they produce sufficient gas for illuminating the factory in which the manufacture is carried on.

It is asserted that articles made of this vegetable wool are not attacked by vermin; it maintains an even degree of heat, is a sure preventive against humidity, and is especially recommended for rheumatic patients.

Professor Betschler, of the Clinical Institution, and Professor Ebers, of Breslau, both strongly recommend these products; and they are extensively used in the Royal Hospital at Berlin. Whether they deserve or not all the high encomiums that have been passed upon them, it is nevertheless an important fact that a material, before considered useless, is now converted into articles of domestic utility and commercial importance.

The utilisation of waste leathers, such as leather scraps, &c., is rather a difficult process. Shortly after the publication of my work on Waste Products, I received a letter from a manufacturer at Leicester, who stated that he possessed 20 tons of leather scraps, which he wished to convert to some useful purpose. He had made many experiments to procure glue from them, but the difficulty of separating the tannic acid was so great, that he had been hitherto unsuccessful. My correspondent directed my attention to a patent, granted to Obadiah Rich in 1864, for separating tannic acid from leather, which, in practice, he had found unsuccessful. In Dr. Miller's "Chemistry" (vol. iii., p. 773) it is stated:—"Stenhouse finds that when threads of thin leather are digested, in a Papin's digester, with lime and a considerable quantity of water, the leather is almost entirely decomposed; the tannic acid combines with the lime, forming an insoluble compound, and a glue of good quality is obtained on evaporation; the solution amounting, on the average, to 25 per cent. of the leather employed. Thick sole leather does not yield glue or gelatine when similarly treated." Analysis did not indicate any considerable difference in the composition of these different leathers. The utilisation of leather scraps is a subject of much importance, even to the town of Leicester, where from five to six tons of leather scraps are made weekly, which are mostly burnt, or at best employed as manure. There is one use, however, to which they are applied largely in the United States and on the continent—the manufacture of "shoddy leather"—a manufacture from refuse scraps, which are reduced to a pulp by grinding and maceration, and converted into solid "sides" of leather by pressure. The article thus produced is used mainly for inner soles.

There is an American story told of a man who, upon being informed that a disciple of St. Crispin kept a "pancake shop," found himself at fault when he politely inquired for Mr. Jones, the pastry baker. Those unlearned in the singular nomenclature which attaches to every branch of the shoe business may be informed that "pancake" is a sort of nickname for a combination of paste and leather, which is used in the manufacture of heels for some qualities—not the best—of shoes. The more polite and proper term is "pasted stock." It consists of a number of layers of very thin leather, which are the odds and ends cut off by the tanners from whole sides; these are made quite compact by means of a layer of paste between each layer of leather, until the whole is about an inch thick, when it is placed between two iron rollers, and subjected to a tight squeeze, after which it is dried, and is then ready for use. The pancake, when finished, is in blocks or cakes, perhaps four inches wide by twelve long, and half an inch in thickness, and looks like a cross between a sheet of gingerbread and a huge cake of tobacco. Hence, I presume, its name.

There is a great "pasted stock" manufactory in the large shoemaking town of Lynn, in America, which employs between forty and fifty men and girls, who are occupied in cutting out the leather and pasting it together. The extent of the business may be inferred from the fact that they make up four barrels of flour into paste every week, and consume I don't know how

many tons of scrap-leather, which is made into pancakes, inner-soles, stiffenings, and the like. They have a powerful steam-engine, which runs a rolling-machine, and a large boiler furnishes steam for making paste and heat for the drying-room. In this room the blocks or cakes before spoken of are placed, and all the moisture taken from them. This firm does a large business, and their method is interesting to those who have any curiosity to know to what an extent economy is practised in the use of material for the manufacture of boots and shoes. Much material that was formerly considered valueless is now put to good use, thus reducing the cost of those necessaries of life, which are high enough, as everybody knows, even with the economy which is now practised.

For some years past numerous attempts have been made to utilise furnace slags. Dr. Paul drew attention to this subject a few years ago, and Dr. Finch has described the method adopted abroad to effect this object. The slag is run into pits eight or nine feet in diameter, and when cool it is cut in the form suited for paving, for which purpose it is used at Metz, Paris, and other places. In England it is not likely to compete with good paving-stone.

Cinders from fineries, puddling and reheating furnaces, and scale from rollers, squeezers and hammers, contain from 40 to 70 per cent. of iron in globules of various sizes dispersed through them. These cinders and scales are equal to 30 or 40 per cent. of the iron turned out. It thus appears that the iron wasted in the cinders is no less than from 12 to 28 per cent. as compared with the iron that is utilised.

The thought to give a more practical use to the many thousands of tons of cinders that are drawn from the puddling and heating furnaces, and which are by most of the rolling mills thrown away as useless, or, in the best case, used up as admixture to iron ores in blast furnaces, in order to increase the quantity (but certainly not to improve the quality) of the iron, has occupied attention for some years past. Mr. A. L. Fleury made numerous experiments on a practical working scale. Chemical analysis showed that these cinders contain invariably from 25 to 50 per cent. of metallic iron, combined and mixed with sulphur, silica, lime and alumina, forming a brittle compound of a very peculiar construction, defying the most ingenious devices of the ironmasters. Mr. Fleury states that at Troy, New York, near the Troy and Albany Iron Works, are many thousand tons of these puddling cinders spread over the streets, every hundred pounds of which contain from thirty to thirty-five pounds of good iron. After many unsuccessful attempts, he succeeded in extracting good cast, as well as wrought iron, and was even so fortunate as to produce from this refuse material a good quantity of cast steel. Two great difficulties had to be overcome; first, the oxides and metallic iron are in these cinders combined with silica and other substances in such a peculiar way, that, by remelting the same in the puddling, cupola, or other furnaces, very little of the metallic iron can be extracted, the combination withstands even the high heat in a steel crucible, no sufficient per-centage of iron can be extracted to make it pay; second, it was found that by re-working the cinders with lime alone, or with lime mixed with charcoal and clay, the product was invariably red-short, and many times red and cold-short (brittle at a bright red heat, as well as when hammered cold). The sulphur remained still combined with the iron, equally so the silica and phosphorus—the three devils or evil spirits of iron. All attempts to extract good neutral iron from the puddling cinders by dry admixture of lime were unsuccessful: there was no other way open but to destroy or loose the tenacious chemical combination of these substances before they were placed into the furnace. Unslacked burnt lime has the peculiar property to decompose silicates during the act of hydration, or slacking, as it is commonly called. This can be easily demonstrated by pouring water slowly into an intimate mixture of sand and fresh burnt lime; the outside of the sand grains will yield to the lime's gelatinous silica, and, when mixed, form with it a strong chemical combination, silicate of lime—the base of a good mortar. Taking advantage of this chemical fact, Mr. Fleury mixed a proper per-centage of powdered burnt lime with the fine ground cinder, and after wetting the whole with water, exposed the mixture to the drying influence of the atmosphere The dry compound was then heated in a common puddling furnace, and treated like pig iron. He obtained 50 per cent. of wrought iron, which, however, retained still some traces of sulphur, leaving the iron somewhat red-short. To extract these last traces of sulphur he dissolved in the water, which he used for slacking the lime, a small per-centage of a chlorine salt, and his expectations were thoroughly realised. The process is also applicable to the working of silicious ores, and can be performed in the puddling, cupola, or blast furnace; it can also be worked to advantage in Bessemer's, Nystrom's, Swett's, and other similar furnaces. The preparatian of the cinder, cost of lime, salt, &c., does not exceed two dollars per ton, and the result is, if properly worked, invariably a good quality of iron.

In one of my former papers I touched upon the subject of recovering the tin from the tinned iron which was wasted. This utilisation becomes the more important now that the price of tin is so much higher. The make of tin plates exceeds 600,000 tons per annum, and is annually increasing, and five or six per cent. of tin may be recovered. The difficulty is to entirely separate the iron. At the London Exhibition of 1862, Messrs. C. and E. Kühn, of Vienna, drew attention to their chemical process of procuring pure tin, good weldable iron, ammonia, Prussian blue, and some other minor articles, out of the worthless waste of tinned iron. Mr. Higgin, of Manchester, now utilises the tin from waste tinned-iron (scrap tin) in the manufacture of stannate of sodium.

A few years ago Mr. J. Webster, of Birmingham, took out a patent for utilising the waste flux from galvanising works. This waste or spent flux was formerly sold at a cheap rate, mainly for reconversion into metallic zinc, but by his process the precipitates find a ready market among refiners, and for making paint.

Few persons have any idea of the enormous quantity of steel hoop and wire manufactured for the millions of crinolines used, and as fashion gradually changes, the utilisation of these cast-off hoops becomes of consequence. Thousands of these are said to be thrown into the streets of New York and other large American cities, where they are a nuisance and a plague to passengers. The *chiffoniers* utterly reject them, as not worth picking up, and the dustmen do not like them, as they are not very portable. Some witty journalist suggests they might be used with a pole in the centre for a rosary or trellis work in gardens. At any rate some plan should be adopted to utilise this great waste of steel in cities, so that old crinolines may be gathered with as much avidity as old rags and papers are now.

There is another waste substance which *is beginning* to be utilised, to which I drew attention some years ago in a paper I read here on the gums, resins, &c., of commerce.* I allude to the abundant supplies from the semi-solid pitch lake of Trinidad, which covers about a hundred acres. In a new magazine for January there is a special article on this pitch lake, which concludes as follows:—"Considering the uses to which cheap asphalte might be applied in road-making as a substitute for stone, as a roofing material, as fuel, as an oil producer, and as a colour maker, and considering, too, that the so-called waste on purification is capable of being utilised and turned to profitable account—it is matter of surprise that energy and capital have not yet been found to undertake the utilisation of the pitch lake." Now, within the last

* See *Journal*, vol. iv., p. 13.

few years, commercial attention has been very prominently drawn to this article. In the report of the North American Commissioners, appointed to inquire into the commerce of the West Indian Islands, Central and South America, submitted to the Governor-General of Canada, in 1866, it was stated that two companies, one English and the other American, had been established to work this pitch lake, and to ship the product, in blocks of asphalte, or refined as petroleum oil, and this article bids fair to become one of the most important articles of commerce in the island. The distillation of oil has, however, been given up, merely owing to the insalubrity of the locality. One of the companies had contracted to supply a French firm with 1,500 tons of the pitch per annum, in the form of asphalte blocks, for paving, at nine dollars a ton free on board; and also to furnish a firm at Antwerp with 20,000 tons yearly, at 50s. a ton, to distil for oil. The pitch or asphalte is, however, rather an objectionable cargo with shipmasters and insurers, from its dead weight, &c. While in charge of the Trinidad products at the Paris Exhibition, I had many inquiries as to the prices of this asphalte.

It is a well-known fact that more than nine-tenths of the sulphur used in the manufacture of soda is retained in the material called "alkali waste," which is thrown away by the manufacturer. Thus is presented a problem, which, if it can be solved, would effect a large reduction in the cost of soda. Many chemists, both scientific and practical, have given a great amount of attention to this subject. The soda manufacture is estimated at upwards of two millions sterling in value, and as the main cost of production is some £5 per ton for sulphur from pyrites, any reduction on this would be an enormous gain to the manufacturer.

In the factories where albumenised photographic paper is made, a considerable quantity of paper is spoiled in the process, and it is then of but very little use. In Paris and Berlin this paper has always been washed as free as possible from the albumen, and then worked up into envelopes. Dr. Jacobson has found a new use for this paper. He proposes to stain it with aniline colours, and to employ it for labels, covers of boxes, and general decorative purposes, By being splashed with concentrated alcoholic solutions of the various aniline colours, the waste of these albumenized papers is now converted into marbled paper of a much more beautiful appearance than what is produced by the old process, from the green-gold lustre which the films of those substances possess. The papers obtained by this method retain the gloss, the bright "satin" surface, of the albumenised material, and are almost as brilliant by transmitted as by reflected light. They are said to be well adapted for shades, transparencies, paper lamps, and other means of decorative illumination.

In conclusion, I may state that I have only skimmed over the surface of this great subject; for, to have enumerated only the various useful applications of residues or waste which have been made in the last ten years would have occupied all the time at my disposal this evening. It may, however, be confidently asserted, that as man advances in scientific knowledge, he will discover means of utilising everything now considered as waste, and we shall realise the fact that the Great Creator has made nothing in vain. Certainly the thanks of the community at large are due to the long labours of the Society of Arts in collecting, publishing, and discussing every subject and suggested improvement calculated to benefit the wide domains of Art, Manufactures, and Commerce, on which not only so materially depends the progress of our commerce and our high status among European nations, but also the well-being, the intellectual advancement, and the artistic taste of our people.

## DISCUSSION.

Mr. YATES said that he had been connected with the iron manufacture, and therefore knew the importance of utilizing the slag, and a friend of his, a clergyman at Brighton, had recently been making some experiments on the subject, the result of which he had hoped to lay before the meeting; at the last moment, however, his friend had informed him that his results were not so perfect as he could wish. He must therefore defer an account of these experiments until another opportunity. As connected with the subject of utilizing waste products, however, he had placed on the table a model of a machine for drying brewers' grains, which had been found very useful. Hitherto grains had been chiefly used for the feeding of cows, and in the wet state, but in this way they were sometimes injurious to the animal, and always so more or less to the milk. On being dried, however, they were perfectly wholesome, and a friend of his who had kept cows, told him that by giving 6 lbs. a day of the dry material, an additional five quarts of milk were obtained, and an increased quantity of butter. The subject was of some importance, since about seven millions of quarters of grain were annually used in brewing and distilling in the United Kingdom, of which one-third was recoverable. He had asked his friend Mr. Milburn, who was carrying on the process, to be present, and he would doubtless give further details.

Mr. MILBURN said his attention had first been drawn to the subject at the time of the cattle plague, when brewers were paying to have their grains taken away. On trying several experiments it was found that there were considerable quantities of carbonaceous and albuminous products in the grains, and it was evident, therefore, that they would be useful for feeding if they could be properly dried, not only for cows, but also for horses, sheep, and pigs. After trying several processes his firm introduced, in conjunction with Mr. Norton, the patentee of the Abyssinian Tube Well, the machine of which a rough model was before the meeting. Heated air was driven by a fan into a revolving chamber, consisting of several floats or trays, in which the grains were placed, the whole being either partially or wholly surrounded by a steam-jacket, and the result was a product which resisted all fermentation, which would keep any length of time, and was readily transported. The same process was now being applied to spent hops, which, when dried, were found to make capital litter for horses, and so produce in this way manure more valuable than straw litter, inasmuch as it was more absorbent. He believed that Messrs. Allsop had introduced it and found the health of their horses was considerably improved in consequence. The same system was also applicable to the drying of corn. In reply to a question, Mr. Milburn said this was not the same system which had been tried at the brewery at Tottenham-court-road and had failed.

Mr. HEWETT asked if Mr. Simmonds could inform him of the cost of the slabs of wood fibre as prepared for paper making, as compared with wood; for although evidently brittle, it might take the place of wood for many purposes where strength was not required, if sufficiently cheap.

Mr. SIMMONDS said he had not the figures by him, but the cost was comparatively small.

Mr. WARRINER said allusion had been made in the paper to the chiffoniers of Paris, but nothing had been said of those of London, although connected with this was a most important question. It appeared that the refuse grease and kitchen stuff in Paris was utilised to a great extent, but in London there was an immense amount of waste. He had been studying this subject for the last three years, and could therefore speak with confidence upon it, and he was quite sure that as much material was wasted as would feed a million pigs. There were sanitary laws telling people to burn their potatoe peelings and cabbage leaves, simply because they lacked municipal regulations which would provide for the removal of these things every day. To show the loss which was thus sustained, he might mention that at Aldershot each regiment of about 500 men got about £4 per month for their refuse of this description, and of

course in their case the strictest economy was used, very different from the system in private families. He calculated that from every family of twelve individuals, living at the rate of £300 a-year, there was enough refuse to keep two pigs, and if all this could be utilised, there would be an immense saving to the country.

Mr. BOTLY said the subject of the paper was of the utmost importance, and he could only hope that we should take a lesson from the French in the utilisation of waste. He could confirm a good deal of what Mr. Warriner had said, for some years ago he was acquainted with a farmer at Aldershot, who kept eight or nine hundred pigs entirely on the refuse of the camp. Having been associated many years ago with Mr. Tomlinson in establishing a Mechanics' Institute in Salisbury, where that gentleman's zeal, energy, and ability were of the utmost service, he was much pleased to see him officiating as Chairman that evening.

Mr. F. BUCKLAND (being called upon by the Chairman) was very glad that the subject of fish had been mentioned in the paper, for he did not believe there was any to spare in the shape of waste. They had not many tunny-fish or sharks on their shores, but there was no objection to fishermen catching as many dog-fish as they could, and he believed that even now many were captured and made to do duty as haddock. He hoped they would not become hippophagists, for although he had once been one himself, he had suffered so much for a week after the great dinner at the Langham Hotel, that he was now quite content to leave horseflesh to the dogs and cats. With reference to some of the waste products mentioned in the paper, he had no hesitation in saying that the high price of salmon was in a great measure owing to the enormous quantity of deleterious matters which were now thrown into rivers. The Tees was more often the colour of milk than of water on account of the refuse from the lead mines, and the same with the Weir. In some places catch-pits were now being made to intercept the poisonous ingredients, and he would recommend Mr. Simmonds, if he wanted to make his fortune, to devise some means of turning this refuse material to account, for one of the large proprietors in that part of the country had told him (Mr. Buckland) he might put up any apparatus he liked, and was welcome to all the lead he could catch. Near Chester was the Dee, which was polluted by petroleum being poured into it, and the consequence was that the salmon would not enter the river. There were hardly any fish in the Dovey, on account of the lead mines, while other Welsh rivers were almost choked up with the refuse from slate quarries. Coming further south they reached the Usk, near which there were very large tin-plate works, which sent large quantities of sulphuric acid into the river and poisoned the fish, notwithstanding that this substance was so valuable for other purposes. The Camel and the Fowey were spoiled from the quantities of mud thrown into them from the different clay works on their borders, for the fish could not spawn on mud. The Fowey had been nearly ruined, over 6 cwt. of fish having been killed in one hour by pumping into it the water from an old mine, in order to get at some iron at the bottom. The water was charged with arsenic and iron salts, and an enormous number of fish were killed. He was glad to say that the Duke of Bedford was now putting a clause into his leases, forbidding the pouring of pollutions into the rivers, and the Duke of Northumberland and other owners the same. In the Exe, and many other rivers and streams, the fish were destroyed by chloride of lime from the paper mills, so that there was not only the loss arising from the waste of such a valuable product, but also indirectly much greater loss by the country being deprived of a large and cheap supply of fish.

Captain J. SELWYN, R.N., said it would take a long time to go in detail into the numerous topics brought under their notice in the paper. He would, however, briefly touch upon two or three of them. First, with regard to the importation of meat from Australia, it was patent to all that a grievous error was committed when large quantities of meat were boiled down for the sake of products not fit for human food. The Society of Arts had very properly directed its attention to the question of the preservation of this meat, and the best method of bringing it over; but, in his opinion, the simplest and best process of preserving meat was that by which seamen had been fed for many centuries—salting. The only difficulty was that in warm climates the salting could not always be satisfactorily conducted, but this was obviated by the use of saccharine matter, instead of salt, particularly in countries where sugar was a natural product. In this way he believed the meat could be imported in a perfect condition for the use of English labourers, if only a certain amount of prejudice on their part could be overcome. The next question was that of condensed fuel. It was, perhaps, known to many that he was particularly interested in this question; but he attached great importance to the word *condensed*, and was of opinion that any substances or compounds which only professed to give about the same evaporative power as the fuel now in use, were not worthy of such investigation or such close experiment as those fuels which gave the power of carrying large calorific effect in small compass. One of the things which Mr. Buckland spoke of as being thrown into the river, he thought no one in his senses would now so dispose of any more than they would coal, for every ton of petroleum was capable of producing the same effect as three tons of coal, and it was much more portable. It had also the valuable property that it could be burnt with no more air or draught than was necessary to support combustion, so that, instead of wasting the heat up a chimney, they got the actual calorific value of the fuel, which never was, and never could be, the case with coal. Mr. Simmonds had given, in a few terse words, a receipt for making a fortune—"Use what others waste"—but he had not shown them how to overcome prejudice, or to impress on each individual in the community the importance of small economies. Manufacturers would still insist on throwing sulphate of copper, chloride of lime, and a thousand other matters, into rivers, which would be very valuable if only put in the right place. People even put up expensive works for the purpose of pumping sewage into the Thames. All these mistakes could only be remedied by the reading and discussion of such papers as that they had heard. Mr. Simmonds had shown them some most interesting specimens of different forms of vegetable fibre as applicable to the making of paper; but it was also true that they could make from these materials a kind of wood, or something very nearly approaching it, and something, too, which had greater powers of resistance than most descriptions of wood. This could be done with vegetable fibres, which had hitherto been thrown away, and with matters such as sawdust; and the product could at the same time be made to assume that particular form that was most useful. Not the least of the advantages was, that they could give a tensile strength to resist crushing which was measurable and under direct control. If it were desired to put an efficient backing behind an armour-plate, wood could not be used, because the exact resistance to impact which it would afford could not be regulated; but this end could be attained by a substance made for the purpose, which would give just that cone of dispersion which was required. With regard to the utilisation of liquid fuel, he might mention that having by accident some sheet iron covered with lead paint in front of a furnace burning this liquid fuel, and giving a temperature of about 4,000° as nearly as could be estimated (the temperature at which firebrick just began to melt), the extreme heat drove off the whole of the oxygen in the oxide of lead paint, and gave up the metallic lead in the shape of drops, which he collected as they fell. With regard to the saving of old crinolines, it might be mentioned that the textile strength of steel was increased

from about 36 tons per square inch to something like 50 tons by being drawn into wire, and, therefore, if the supply were at all constant, it would be worth some trouble to prevent the waste of such valuable material, but owing to the rapid changes of fashion he did not look upon the subject as of any practical importance. With regard to the recovery of waste alkali and other matters held in solution in water, it should be borne in mind that the cheapest process was that of evaporation. A very enthusiastic gentleman had given it as his opinion that all the motive power required in the world might be obtained from the sun, but without going quite so far as that, he was fully persuaded that if the system of simple evaporation were adopted, as in the manufacture of salt from sea water, many products now discarded might be turned to good account. Wherever there was a factory in England, there was always a stream of white vapour to be seen issuing from it, which was only an indication of waste heat, or waste of power. It was inexcusable in a great manufacturer, having a quantity of steam at his disposal, to employ it, as was often done, simply in boiling the fish in the nearest stream. The main difficulty with many of these products, such, for instance, as the pitch from the Trinidad lake, was in the condensation previous to transport, so that the cost of freight should not be too heavy. But wherever there was a calorific material, there was the means of effecting condensation; and he did not think there would be much solid foundation for the plea of unhealthiness, if the native labour available on the spot were employed. In conclusion, he remarked that he had no sympathy with the idea which Mr. Warriner seemed to put forward, of economy by Act of Parliament or municipal regulations, but he believed the true source of improvement in these matters would be private enterprise. He had no doubt that in electro-plating would be found a means of utilising the sulphate of copper which was now used to poison the rivers, by extracting the pure metal, while he had, to a certain extent, endeavoured to use the product in another way in some of the hop countries, by introducing it as a preservative for the hop poles. He hoped that before long scientific men would come forward and teach us how all these matters which were so desirable could be accomplished. The last observation he had to make was, that on all these subjects the appeal was constantly made to inventors to teach us how to economize. Could we then avoid the inference that the rights of inventors to protection and fair remuneration cannot be ignored, and ought to be of interest to every one who hopes to obtain economic results or to hasten the progress of applied science?

Dr. ELLIS suggested that encouragement should be given to able and enterprising investigators in the wide field which had been spread before them by the offer of prizes for discoveries in the wished for direction. These discoveries were not made without great labour and perseverance, and when made they often entailed loss, disappointment, and litigation on the inventor who endeavoured to protect his rights; whereas, if a suitable reward were held out for useful discoveries, or if there were a proper tribunal for investigating such matters, there would be something on which a man could rest his hopes, and those who had enterprise and skill would be encouraged to work more for the public good when they had less likelihood of doing so to their own loss.

Mr. CAMPIN said he had often remarked the large quantity of old boots and shoes and pieces of tin which lay about the unfinished roads in new districts, and he suggested, as these things were shown to be useful, that some of the destitute poor should be employed in collecting them. He also remarked that if something could be found which would serve as a substitute for flour in the making of paste, a large quantity of food material would be set free.

The CHAIRMAN did not wish to complain of the paper as being too full, but at the same time he thought they would not have had quite so discursive a discussion if fewer subjects had been taken up, and each more elaborately treated. He thought the first thing necessary was to define what was meant by a waste product. For instance, he did not think sharks in the sea were a waste product, and no doubt they had their uses in keeping down too rapid an increase of the smaller fish. There were some other things mentioned in the paper which he should not be disposed to consider waste products. The meaning, then, of the term being determined, the following questions suggested themselves:—Given a waste product, what could be recovered from it; what would be the cost of recovery, of collection, and, if at a distance, of carriage to the locality where it could be usefully treated. There were no doubt a large number of so-called waste products spread over the surface of the earth, which would cost more to collect and bring to market than they were worth, and so an apparently cheap article became in reality a dear one. He believed that was the reason why many of the grasses in different parts of the world had not been earlier introduced for the manufacture of paper. Many years ago he had prepared an article on this subject for the *Quarterly Review*, and he then arrived at the conclusion, that by the employment of straw and other vegetable fibres, paper of a very brittle texture was produced, and that was the reason why esparto and other fibres were not more extensively used, to say nothing of wood shavings. The cost of conversion was a very important element in the question of utilising waste materials; did time permit, he could give many examples of this, but one would suffice. Mention was made in the paper of alkali waste produced in the manufacture of carbonate of soda from common salt, and the quantity of this was so great that land had really to be bought on which to put it. Yet it was perfectly possible, and even easy, to recover the whole of the sulphur from this alkali waste, and the only reason why it was not more extensively done was, that sulphur could be imported at a cheaper rate than it could be made in this way. Some years ago, when the Government of Naples thought proper to set aside a treaty with England, and sell the whole of the sulphur in Sicily to a French company, the price rose immediately, and during the few months that elapsed before the trade was thrown open again, no less than fifteen patents were taken out for making sulphur from alkali waste. There was little doubt that had there not been a renewal of the supplies from Sicily, and had not other methods of procuring it, such as that from pyrites, been discovered, this would have become an important manufacture. At the last Exhibition, some beautiful specimens of sulphur were shown almost chemically pure, prepared from alkali waste, but the difficulty was that it could be imported more cheaply. These were the points on which discussion would be useful, and they were much indebted to Mr. Simmonds for the amount of labour and research he had brought to bear upon the subject. Such matters were well worthy the attention of the Society, and the subject was indeed of national importance. It might, he thought, be useful to offer premiums for discoveries in certain directions, but, until waste products could be utilised almost on the spot where they were produced, it was useless to abuse manufacturers for getting rid of them in the easiest way possible.

Mr. SIMMONDS, in replying to the observations which had been made, said he had endeavoured to save himself from such strictures as the opening one of the Chairman, by adding a sub-title to his paper of "Undeveloped Substances," and he still thought there was scope for enterprise in the direction he had pointed out, even amongst the sharks. He did not agree with Mr. Warriner's views as to the utilisation of domestic waste for the keeping of pigs, which he did not think very desirable on a large scale in the neighbourhood of great towns, and still less so on the Irish system of having a pig-stye at every back door. Mr. Buckland was quite right in saying that too much waste was thrown into rivers, but this matter was being cured by legislation. His object had

been, not so much to give detailed practical information how waste substances might be utilised, as to throw out hints and suggestions, which he hoped might be taken up by inventors, as to what might or might not be utilised. Some of the instances he had mentioned showed that he had been correct in the anticipations he had made in former papers on the same subject. It would have been impossible for him to go into all the topics which had been suggested, as almost any one of them, if treated at length, would have occupied an evening. Starch, for instance, was made to a considerable extent from horse chestnuts, and many other vegetable matters might be utilised for this purpose instead of wheat. He could not agree with Capt. Selwyn as to salting being the best method of preserving meat, nor did he think such provisions would find favour with the population, and unfortunately the countries where animal food was so abundant were not sugar-producing countries.

Captain SELWYN said sugar might easily be made from corn in Australia.

Mr. SIMMONDS believed that at present Australia had to import wheat for her own use, and although he knew the production was largely increasing, he doubted the economy of converting it into sugar. He was glad to find that his paper had elicited so much discussion, for the more such questions were debated and investigated, the better would it be for the community at large.

The CHAIRMAN, in proposing a vote of thanks to Mr. Simmonds, mentioned that Dr. Redwood, of the Pharmaceutical Society, had a process of bringing meat from Australia, in a perfectly fresh state, by dipping it into paraffin. The solid paraffin was melted, and the meat then dipped in and taken out, retaining a coating which was impervious to air, so that the meat could be preserved for almost any length of time. When the meat was to be cooked it was simply dipped into hot water, which melted the paraffin, and it was then ready for use.

The vote of thanks was then passed unanimously.

The paper was illustrated by numerous specimens from Mr. Simmonds' private collection, and by waste vegetable substances, and papers made therefrom, kindly lent by Mr. E. Lloyd, of Bow.

## BARON LIEBIG "ON A NEW METHOD OF BREAD-MAKING."

The following is from the *British Medical Journal*:—

"Baron Liebig has just made some important researches on a new method of bread-making. He remarks on the stationary character of this art, which remains to the present day much in the state in which it was thousands of years ago. He dwells upon the sanitary importance of the mineral constituents of grain, and the necessity of a sufficiently abundant supply of them in bread. These are best found in certain kinds of black and brown bread, which are, therefore, more wholesome than the white bread that is nevertheless preferred by most people (especially by the lower orders) on account of its better appearance and superior palatableness. The problem has hence arisen, how to provide a beautiful white bread which shall contain all the essential mineral constituents of black bread. These mineral constituents (phosphate of potash, lime, magnesia, and iron) are introduced into the bread by the use of the baking-powder invented by Professor Horsford, of Cambridge, in North America. This baking-powder consists of two powders, the one acid, the other alkaline. The acid powder is phosphoric acid in combination with lime and magnesia; the alkaline powder is bicarbonate of soda. Two measures, made of tinned iron, the larger one for the acid powder, and the smaller one for the alkali, are employed. When bread is required to be made, every pound of flour is mixed with a measure of the acid powder and a measure of the alkali powder, and sufficient water added to make dough, which is presently made into loaves and baked. In one and a-half to two hours bread may be made by this process. The chemical change which takes place will be easily intelligible; carbonic acid is generated, and phosphate of the alkali is formed, at the same time. The essential feature in Horsford's invention is the economical getting of phosphrico acid in the shape of a dry white powder. This is done by taking bones, burning them, and then treating the well-burnt bone-earth (which consists of phosphate of lime and magnesia) with a certain quantity of sulphuric acid, so as to remove two-thirds of the lime, and leave a soluble superphosphate of lime. The sulphate of lime which results from the action of the sulphuric acid is separated from the rest by filtration and the solution subsequently concentrated by evaporation, and when it becomes very concentrated, mixed with a certain quantity of flour, and dried up. The mixture of flour with the superphosphate admits of being reduced to the finest powder, and constitutes the acid powder just referred to. It will be observed that the alkali-powder contains soda, whereas potash is required in order to furnish the right kind of mineral salts. Liebig proposes to rectify this defect by using a certain quantity of chloride of potassium along with the alkali. Chloride of potassium is now tolerably cheap, owing to the finding of immense quantities of it at Strassfurt. Baron Liebig, in order, as he says, to avoid being bothered, has appointed Herr Zimmer, of Mannheim, and Herr Marquart, of Bonn, his agents for his new baking-powder, and those interested may, if they like, get it from them."

## Fine Arts.

STATUE TO VOLTAIRE.—The subscription lists opened in Paris for the purpose of raising a statue to Voltaire have yielded the sum of £1,436, which is considered sufficient for the purpose. The model chosen is that of Houdon, which is being produced on an enlarged scale, by the house of Barbédienne. The monument is to be placed at the end of the Rue de Rennes, close to the Institut of France.

MONUMENT IN COMMEMORATION OF DUTCH INDEPENDENCE.—One of the largest, if not the largest, public monument is to be inaugurated at the Hague in the course of the present year. It is to commemorate the revolution which gave independence to the states, and will be more than seventy feet high, and carry seven bronze figures of colossal dimensions. A circular flight of steps, surrounded with candelabra, will form an approach to the monument, the basement of which will be ornamented with bas-reliefs and inscriptions. On pedestals projecting from the basement will be placed the following statues: — In front, a statue of Guillaume I., four mètres in height; on the sides, two figures representing Religion and History, each three mètres high; and at the back, a group of three figures, representing the Counts Hoogendorp, Limburg, Stirum, and Van der Duyn Van Maasdam, the heroes of the War of Independence, and members of the Provisional Government. The upper portion of the monument will be decorated with the arms of Holland, and of the nine provinces, enriched in garlands; and on the summit is to be placed a female figure symbolical of Liberty and Independence; in one hand of the figure is to be the national flag, and in the other the attributes of the seven enfranchised provinces. At the foot of the figure will be the Dutch lion freed from his chains.

ROUEN ART EXHIBITION,—The annual exhibition of works of art at Rouen has always been one of the most important of the provincial exhibitions of France, although the town is so near Paris. This year it promises to assume a much more important character than before; the Municipal Council has resolved to raise its grant towards the exhibition from £270 to £680, in order to enable the Commission to offer greater inducements

to able artists to send their works there. These are not the only funds devoted to the exhibition, the Society of the Friends of Art, which has the organization of these annual shows, has its own subscription list, and, in addition to these funds, there is to be added the amount taken at the doors for admission. After payment of expenses the whole of the proceeds will be devoted to the purchase of pictures and other works of art, and to the defrayimg of the cost of the gold medals to be awarded to the most approved works. The Emperor and the Minister of Fine Arts also subscribe to this latter object. The Rouen Exhibition has heretofore been held in the winter, but this year it is to take place earlier.

## Manufactures.

CHEAP WATCHES.—It will be recollected that some time since a notice was given in the *Journal* of a cheap keyless watch, manufactured in Switzerland, and it was stated, on the authority of a letter in *Les Mondes*, that such a watch could be sold for 25 francs. In consequence of further inquiry, however, this statement was, in a subsequent number, corrected to 35 francs. But, since that inquiry was made, cheap watches, manufactured by machinery, have been imported into this country, of Swiss make; and keyless watches are now to be bought retail in London at a price of 25s. each.

THE BRAZIL MINT.—This large edifice at Rio Janeiro is under the direction of the Minister of Finance. The governor is called the provedor. The steam machinery and pipes for casting and coining, &c., are of the most perfect kind. In the assay of gold, 200 milligrammes are now employed. The refining is carried on in platinum vessels. From July, 1840, to July, 1864, there were struck 38,808,890 gold coins, and 13,765,553,500 silver, besides many medals of various kinds. There is in the mint a collection of the various coins struck in the former monetary establishments of the country, and 572 coins of other countries. It has also 83 dies of Brazilian medals, and 1,027 foreign medals. There is attached to the mint a school for painting, plaster-sculpture, and engraving, and each workshop has its own library.

## Commerce.

RAILWAYS IN RUSSIA.—The length of the railways in Russia is, according to the latest returns, 10,556 versts, of which 5,739 versts are open for traffic, and 4,817 versts are in construction, and which will be opened in the course of the year. The lines in construction are—Sergniewsk to Yaroslaw, on the Moscow and Yaroslaw railway, 200 versts. Schonia to Twanowno, 82 versts; Moscow to Smolensk, 257 versts; Rybinsk to Ossetchensk, 278 versts; Roslawl to Orel, on the Orel and Witebsk line, 250 versts; Yclotz to Orel, 177 versts; Griaz to Berissoglebsk, 197 versts; Rostow to Tambow, 65 versts; Saratow to Tambow, 340 versts; Koursk to Sea of Azoff, 775 versts; Koursk to Kiew, 438 versts; Kiew to Balta, 622 versts; Krementchoug to Kharkow, 247 versts. Balta to Krementchoug, 150 versts; Tiraspol to Kischinero, 65 versts; Riga to Nitau, 40 versts; Finland line, 330 versts; Poti to Tiflis, 288 versts. Besides these, there are about twenty other lines in project, and the greater part will be shortly commenced, as being greatly needed. The most important of these projected lines will be the Oral line, which commences at the Port of Berezowk, on the Xama, and terminates at Tumena, on the Towra. Its total length will be 687 versts. This line will put into communication the eastern and western valleys of the Ural mountains. The total amount of merchandise exported from Europe into Siberia is estimated annually at 20,000,000 of Russian pounds in weight; and from Siberia into Europe at 2,300,000 pounds as the production of the mines in the Ural; 1,200,000 pounds of ores; 2,800,000 tallow, hides, oils; 6,000,000 pounds of provisions; and 1,000,000 Asiatic productions. The saving in transport by the construction of this railway is estimated at above 2,000,000 of roubles, and will no doubt have a most beneficial effect in developing the immense mineral resources of the Uural mountains.

JAPAN SILK.—In the report of the Japan Chamber of Commerce, for the half-year ending June 30th, allusion is made to a fraud discovered in Italy in the silk-worm-egg trade. Certain blank cards appear to have been shipped from Japanese ports by some dishonest persons, marked and stamped with the usual Japanese characters and custom-house certificates, to be covered with Italian seed and sold as produce of Japan. Such an abominable fraud, if successful, would of course imperil the whole of this increasingly valuable trade, and considerable sensation had been created there by the news of the attempt. The Chamber of Commerce has promptly taken up the matter, appointing a special committee to co-operate with his excellency the Italian Minister, in endeavouring to discover the authors of the fraud, and there is little doubt of their success. The eagerness with which the native silk-men have applied for copies of a circular just issued by the chamber, in which are set forth the faults found with Japan silk by European throwsters, encourages the hope that they, too, will gladly help to bring to justice the perpetrators of this silk-egg fraud.

THE FRENCH FISHERIES.—According to the statement published by the Minister of the Marine, the value of the production of the French fisheries in 1867 was 66,745,090 francs, and exceeded that of the previous year by 7,913,170 francs; this is due in a great measure to the unusual success of the sardine fishery. The value of the cod-fish taken in 1867 amounted to 14,665,208 francs; that of sardines to 15,635,816 francs; herrings, 7,737,004 francs; mackerel, 2,357,932 francs; anchovies, 286,867 francs; shell-fish, 3,565,458 francs, of which 970,975 francs are for oysters, and 1,279,631 francs for mussels; in the former amount are only included the value of oysters dredged from public oyster beds, and it does not include the value of oysters taken from private breeding grounds. The value of crabs, lobsters, crawfish, shrimps, prawns, &c., taken, amount to 1,821,718 francs. During 1867 the number of French vessels engaged in fishing on the coast of France, the eastern coasts of England and Scotland, and Newfoundland and Iceland, was 17,544, manned by 70,125 men.

PRICE OF GAS IN ITALY.—The following are the prices per cubic metre of gas paid by private consumers in the principal towns in Italy, with their equivalents in shillings and pence per thousand cubic feet English:—

| | Per cubic metre. Centimes. | Per 1,000 cubic feet. s. | d. |
|---|---|---|---|
| Monza | 50 | 11 | 4 |
| Ravenna | 47 | 11 | 7¾ |
| Chieti | 50 | 11 | 4 |
| Ancona | 50 | 11 | 4 |
| Como | 50 | 11 | 4 |
| Lodi | 47 | 10 | 7¾ |
| Florence | 50 | 11 | 4 |
| Palermo | 48 | 10 | 10¾ |
| Naples | 45 | 10 | 2½ |
| Modena | 50 | 11 | 4 |
| Parma | 47 | 10 | 7¾ |
| Pavia | 50 | 11 | 4 |
| Milan | 45 | 10 | 2½ |
| " to large consumers to | 40 | 9 | 3 |
| | 55 | 7 | 11¼ |
| Novara | 50 | 11 | 4 |
| Casali | 48 | 10 | 10¾ |
| Venice | 47 | 10 | 7¾ |
| Alessandria | 45 | 10 | 2½ |
| Messina | 45 | 10 | 2½ |
| Genoa | 37 | 8 | 5 |
| Cuneo | 54 | 12 | 3 |
| Turin | 26 | 5 | 10¾ |

## Colonies.

THE PUBLIC DEBT OF NEW SOUTH WALES.—The official statement up to 31st October, 1868, shows the amount of the various loans and the objects for which they have been raised:—

| | Authorised. | Amount raised. |
|---|---|---|
| Loan to Sydney Railway Company | £216,571 .. | £223,936 |
| Sydney Sewerage | 200,000 .. | 201,149 |
| Sydney Water Supply | 200,000 .. | 201,264 |
| Public Works | 178,750 .. | 136,890 |
| Railways | 666,800 .. | 630,105 |
| Railways and Public Works | 445,323 .. | 393,427 |
| Do. do. | 1,782,370 .. | 1,696,828 |
| Public Works and Railways | 161,832 .. | .. |
| Public Works | 670,025 .. | .. |
| To pay of Land Immigration Debentures | 73,776 .. | 70,300 |
| Do. do. | 130,400 .. | 130,311 |
| Railways | 300,000 .. | 300,895 |
| Public Works | 107,717 .. | 107,787 |
| To pay off Debentures | 14,500 .. | 145,007 |
| Railways and Public Works | 770,100 .. | 761,852 |
| To pay off Debentures due in 1860, and Public Works | 713,823 .. | 602,696 |
| Voluntary and Assisted Immigration | 55,000 .. | 54,945 |
| To cover deficit of 1864, and to pay Debentures | 850,000 .. | 765,596 |
| Public Works and Immigration | 1,043,300 .. | 252,694 |
| To cover deficiency of 1863 and previous years of Treasury Bills | 400,000 .. | 391,849 |
| | £10,424,324 | £7,486,748 |

There has been repaid £869,200, leaving a balance still due of £6,917,630.

## Obituary.

WILLIAM EWART, the late member for the Dumfries Boroughs, died at his seat Broadleas, near Devizes, on the 23rd January, at the age of 70. The second son of the late Mr. William Ewart, merchant, of Liverpool, he was born at Liverpool, in the year 1798, and received his early education at Eton, where he numbered among his schoolfellows Dr. Pusey, Mr. Denison, Speaker of the House of Commons; the late Dr. Trower, Bishop of Gibraltar; the Marquis of Londonderry, and the late Marquis Camden, K.G. From Eton he passed to Christchurch, Oxford, where his poem gained him the Newdegate Prize, in 1819—the subject being "The Temple of Diana at Ephesus." He took his B.A. degree in Easter Term, 1821, obtaining a second class in classical honours. In 1827, he was called to the Bar at the Middle Temple, and in the following year entered Parliament on a casual vacancy for the since disfranchised borough of Bletchingley. At the general election of 1830 he was chosen for his native borough of Liverpool; he was again chosen in 1831, and he also sat for that constituency from the general election in December, 1832, till the dissolution consequent on the King's death, in July, 1837, when Lord Sandon and Sir Cresswell Cresswell were the successful candidates. On the death of Mr. R. Potter, towards the close of 1839, he again returned to the House of Commons as M.P. for Wigan; but at the general election of 1841 he did not solicit re-election by that constituency, but he was chosen, after a contest, for the Dumfries district of boroughs, which he continued to represent down to the dissolution of last year, being returned at every subsequent general election. In the earlier part of his career, Mr. Ewart's name appeared very frequently in the reports of the Parliamentary debates as a speaker, both on subjects of general politics, in which he was always an advanced Liberal, and also especially on commercial matters, with which his early education and associations rendered him particularly conversant. While Lord Melbourne's Ministry was in power he used to bring forward annually a motion for the equalization of the duties on East and West Indian sugar; he also strenuously and unremittingly urged, at a time when he stood almost alone, the mitigation of our criminal code by the abolition of capital punishment for horse and cattle stealing, &c.; and with a laudable zeal on behalf of the working classes and the population of our large and crowded cities, he advocated the opening of our public museums and galleries, and other repositories of works of art, as free from every restriction as possible. He was also among the first to propose, and certainly one of those who by steady perseverence carried, several important Bills for the establishment of Schools of Design. Mr. Ewart will be remembered as having introduced into Parliament the measure known as the "Prisoners' Counsel Act" and also the Free Public Libraries Act of 1850, which is in extensive and useful operation, especially in our great northern centres of commercial industry. He was elected a member of the Society in 1852, and was for many years one of its Vice-Presidents. He took an active interest in its educational proceedings, and at the instance of the Council, he brought in and carried through in the House of Commons the "Literary and Scientific Institutions Act, 1854," which had been prepared by a Committee of the Society.

## Notes.

VELOCIPEDES.—Velocipedes, known in England nearly half a century ago as dandy-hobbies, occupy a vast deal of attention now in France. Manufactories are established on a large scale in Paris and elsewhere, and the new carriages, without horses, are constructed on very scientific principles, light, elegant, and with all kinds of delicate appliances, at prices varying from ten to fifteen pounds. They are generally made with only two wheels, and the word velocipede being too long, it has been abreviated to *velox*, while those constructed with three wheels are called *tricycles*. The manufacturers—one in Paris, at least—have large places in which purchasers are instructed in the management of their carriages, and three or four lessons are said to be sufficient to form competent velocipedists. Many young men have adopted them, and in the country the velox may be seen awaiting its master at the railway-station. In one case, an economical application has been made of the tricycle, the rural postmen of the department of the Aube being provided with them, and considerable time is thereby saved in the delivery of letters in consequence. A box is attached to the machine, in which the postmen are allowed to carry parcels for customers, so that a regular parcels delivery is established in the district, and the charge for the parcels soon pays for the velocipede. The old dandy-hobbies went out of fashion on account of the numerous accidents to which they gave rise, but great improvements have been made in the machine, and its use is taught in a complete manner. The spider-like structure of the velocipede makes it very dangerous to pedestrians at night, and those in Paris are now provided with a small lantern, to prevent accidents.

SECONDARY EDUCATION IN PARIS.—There exists an important educational establishment in Paris, principally intended for the secondary education of youths for commercial employment, called the Ecole Turgot, and which has a well deserved reputation. A new school, which will form in fact a branch of the former, is now being constructed in the Rue Château Landon, to be

called the Ecole Municipal Colbert, which will form a worthy monument to the fame of a second great minister whose views on political economy were far in advance of the time in which he lived. In addition to these, other branches are to be established in the outlying quarters of the city to give secondary instruction to working men in evening classes. It is expected that Lyons, Rouen, Lille, and other towns will follow the example of the capital, in thus extending the means of secondary education for the middle and lower classes.

THE INDUSTRIAL MUSEUM AT TURIN. — The programme of the studies at the Industrial Museum at Turin, for the scholastic year 1868-9, has recently been published by the Director, the Commendatore Devincenzi. These courses are principally intended for persons intending to become professors at technical, professional, and industrial schools, and for managers of industrial and agricultural undertakings. The following is the course of study for students who intend taking the diploma of the professor of agriculture:—

*First year.*

Physical Science, applied to industry.
Chemistry, applied to agriculture.
Rural Economy and Drawing.

*Second year.*

Chemistry, applied to agriculture.
Mechanics, applied to agriculture.
Rural Economy and Forestry.

MEMORIALS OF PUBLIC MEN.—Twenty marble busts have been added within a short time to the sculpture gallery of Versailles. Amongst the notabilities represented are Arago, the astronomer, the poet Béranger, Archbishop Affre, the sculptor Rude, the painter Taunay, the composer Tesueur, the famous orientalist Champollion, the political economists Duquesnoy and Cobden, the chemists Gay-Lussac, and Pelletier, the philosopher Azaïs, the Duc de Larochefoucauld, and several admirals and generals. The council of the Order of Advocates at the Cour Imperiale decided the other day that a subscription should be opened, in the name of the bar of Paris, for the erection of a monument to the late Monsieur Berryer.

POPULATION OF CUBA.—According to the latest census, that of 1861, the number of white persons in Cuba was 793,484, including the creoles or descendants of Spanish or European settlers; the number of mulattoes and freed slaves was 234,493; and those of the black slaves, 370,553. The white population of Porto Rico in 1861 was 300,406. The freed persons of colour, 241,037; and the number of slaves amounted to 41,238.

PUBLIC INSTRUCTION IN GREECE.—In 1866 there were 140 superior educational establishments in Greece, including the Ionian Islands, composed of one university attended by 1,182 students, 16 lycées with 1,908 pupils, and 123 schools attended by 6,675 pupils. The elementary schools were 1,067 in number, of which 942 were for boys, and 125 for girls; the number of pupils in these schools was 52,583, making in all 1,207 public educational establishments, with 62,348 pupils. To this must be added 4 seminaries, 3 orphan schools, 45 private boys' schools, and 48 private girls' schools. Thus the total number of educational establishments in Greece amounts to 1,307, with 67,873 pupils, of which 11,323 are girls. The cost to the State for public instruction in 1866 amounted to 1,323,050 drachmas (£47,250). In Greece and the Ionian Islands, during the same period, there were 77 newspapers and 13 periodical reviews, of which only 19 were established more than 10 years ago. The number of printing establishments throughout the kingdom was 75.

PRICE OF LAND IN PARIS.—The demolitions now proceeding in order to form the two new streets which, with the Rue de la Paix, will give three splendid thoroughfares, diverging at different angles, but all terminating in a *place* opposite to the new opera-house, furnish examples as remarkable as any yet supplied of the enormous market-value of ground in Paris. Amongst the lots of land sold during the latter half of December are the following:—1,175 square metres in the Rues Réaumur, De Grammont, and Richelieu, at 1,200 francs (£48) per metre; 193 metres, at the corner of the Rue Choiseul, at 1,550 francs (£62) per metre; 404 metres in the Rue du Helder, at the corner of the new Boulevard Haussmann, at 1,200 francs; and 558 metres, close to the new opera-house and the same boulevard, at 1,060 francs (£42 8s.). In the same list are found, by way of contrast, 643 metres in the Rue Piat sold at 22 francs; 190 metres in the Boulevard Soult at the same price; and several other plots, at prices varying from 28 francs to 40 francs per metre. With the exception of the extraordinary cases given above, and of one plot in the Rue St. Lazare, which sold at the rate of 726 francs per metre, there is only one instance of ground fetching more than £20 per square metre, and very few over eight to ten pounds.

NEWSPAPERS IN FRANCE.—The number of newspapers published in France now amounts to 1,668, of which 69 political and 710 not political are published in Paris.

NEWSPAPERS IN BAVARIA.—In Bavaria the number of newspapers is at present 392; last year the number was only 357. The number of newspapers published at Munich is 70.

## Correspondence.

FOOD SUPPLY.—SIR,—In his very interesting paper on the "Progress of the Society of Arts," under the head of "Food Supply," Mr. Davenport has hardly done justice to the exertions of the Australian Meat Company. I allude to the words (page 165) "attempts at importation." Our first shipments arrived in England in February, 1867, and up to the present date we have received and sold the produce of over 9,000 head of prime cattle; this shows that the Australian Meat Company have, at all events, got beyond the stage of "attempts at importation." The *Times* recently mentioned the matter in a similar manner, speaking of a few tins of beef having arrived. I write this letter with the object of placing the fact on record that, whatever may be done hereafter by others, "Ramorine" beef, preserved by the Australian Meat Company, was the first Australian meat brought to England in large quantities as a saleable and profitable article of commerce. Those concerned in the question should consider that although our process is not new, we have certainly opened out a new source of food supply. Whether this Australian beef is used among our poor, or on board ship, does not touch the merits of the question, as every pound of beef from a new source used on board ship, is a pound of beef added to the general stores of England. Who actually uses the particular pound of beef is of no importance.—I am, &c.,
C. G. TINDAL.

Australian Meat Company, 52, Gracechurch-street.

MUSICAL PITCH.—SIR,—In reference to the note signed "W. Pole, F.R.S.," on musical pitch, which was printed in last week's *Journal*, I would request permission to inquire if it is not a fact that the standard of musical pitch adopted in France corresponds with that generally accepted by Germany and Russia? There appears to be a diversity of opinion as to what is termed a "reasonable pitch." Eminent conductors of orchestras give a preference to a high pitch. Singers, and those whose practical experience shows them that the conductor's pitch is extravagantly high, advocate a lower pitch. Other circumstances, such as the detriment done to stringed instruments by the extra tension which tuning up to the present pitch involves, the impossibility of now executing certain musical passages in oratorios and operas written a hundred years back, all point to the necessity of a lower pitch. It being assumed, then, that the standards of musical pitch do agree generally on the Continent, surely the right step for England is the adoption of a similar pitch. The advantages of uni-

formity in pitch are many and palpable. As regards the letter on the same subject addressed to the editor of the *Journal*, in which it is stated "that the inquiries which the Society is instituting abroad will probably show that in Imperial France, where imperial gold and imperial will are omnipotent to issue an authoritative tuning-fork, the pitch is not the same at all institutions, even in Paris," is not this statement an unauthorised assumption that it is unnecessary to promote the reform of musical pitch? The differences in pitch which a highly-cultivated musical ear has detected at various concerts in Paris, may, probably, be due to the variations of temperature in such concert-rooms. The advantage, however, of possessing a standard for reference remains the same to the musical instrument manufacturers and musicians. As regards the letter which your correspondent quotes, it is but necessary to remark that that letter commences with the avowal of a battle existing between the voice and musical instruments. Can the writer of the letter quoted be one of the great musical authorities who give a higher rank and consideration to the musical instruments made by M. Antoine Courtois, Messrs. Metzler, Messrs. Rudall and Carte, Messrs. Hart, and others, than to the human voice, a natural musical instrument made by God? This writer further states, that "the progressive elevation of the diapason has, in all ages, been the standard complaint of singers who are approaching the natural termination of their musical career." This statement is an additional argument in favour of a lowered pitch, one more adapted to the human voice; and though the writer evidently does not wish to admit the necessity of lowering the present pitch, still every one must allow that the means within the reach of those who virtually lay down the law in musical matters in England should be taken to extend, if possible, the existence of good voices, rather than support, and persist in, a system which recent events show to be disadvantageous to the human voice.—I am, &c., A. S. C.

February 2, 1869.

MR. DEAN'S PAPER ON XYLOGRAPHY.—SIR,—I have been much interested by reading Mr. Dean's paper on "Xylography." In my opinion there is plenty of room for improvements upon the old system of graining, and Mr. Dean's process seems to be a step in that direction. Without going so far as Mr. Ruskin in absolutely denouncing all imitations, I hold that where the actual material can be obtained it is always preferable, but when this cannot be effected, the nearer approach the copy has to the original so much the better, and this is more especially the case in nature; therefore the result of Mr. Dean's process must be to bring the work nearer to that of nature than the system of hand-graining. Besides this, there are difficulties which, I believe, have not yet been overcome in copying some of the choicest foreign and colonial woods. I may instance the Huon pine of Tasmania *(Dacrydium Franklinii)*, the knots of which correspond with those of the bird's-eye maple, but are exceedingly close together, and are surrounded by a singularly bright satiny lustre. It is this lustre, I believe, which the grainer has hitherto found difficult, if not impossible, to reproduce accurately. There are also the Tasmanian myrtle *(Fagus Cunninghami)*, the musk-wood *(Eurybia argophylla)*, and many other most beautiful woods, the produce of the Australian colonies, which, if they could be faithfully represented in this country, would be most valuable for panels of doors, or for large rooms, or even for cabinet work. The distance, and heavy charges for freight, are probably the only drawbacks to the importation of the woods themselves, as there is no lack of trees in the Australian forests. But setting aside the subject of imitating woods, is Mr. Dean aware that in America sheets of wood are cut so thin that the actual material itself is used in place of paper for walls. These sheets are nearly as thin as paper, and are cut in lengths of about ten feet, and the entire width of the trunk, and appear like the single shavings from a gigantic plane. They are said to be nearly as cheap as paper, and are affixed to the walls in a similar manner, after which they are either rubbed down with oil or varnished. By this process rooms can be papered, so to speak, with bird's-eye maple, curly maple, walnut, hornbeam, birch, and, in fact, with most, if not all, the North American woods, though I am not aware whether the machine by which they are cut is capable of treating in a similar way such hard woods as those of the Australian colonies I have already mentioned.—I am, &c., JOHN R. JACKSON, Curator of the Museum of Economic Botany, Royal Gardens, Kew.

February 3, 1869.

RECOVERY OF SULPHUR FROM ALKALI WASTE.—SIR,—The discussion on Mr. Simmonds' paper took such a discursive form that time would not allow me to offer a statement of some facts relating to this subject, by way of supplement to the reference made to it in the paper, and for the purpose of illustrating the general importance of studying the materials which are the refuse of manufacturing operations. As the quantity of common salt consumed in the British alkali trade amounts to no less than 400,000 tons a-year, and nine-tenths of the sulphur used in the manufacture of soda remains in the waste discharged from the lixiviating vats, the quantity of sulphur which thus becomes locked up as it were cannot be far short of 100,000 tons a-year. This sulphur is now being recovered with a very considerable degree of advantage to the alkali manufacturers, and with the further advantage of preventing that pollution of rivers by the slow decomposition of the soda waste heaps which has been such a fertile source of nuisance at alkali works. The method adopted, which is very simple and inexpensive, is the invention of Mr. Ludwig Mond. Its adoption is, in a great measure, due to the appreciative insight of the late John Tennent, manager of the St. Rollox Works, near Glasgow, where it has been worked some time. This method is also being worked at several other places. The recovery of the sulphur is effected to the extent of one-half of the amount in the soda waste, and at a cost of about £1 per ton. The sulphur thus obtained is very pure, and serves as a substitute for Sicilian sulphur, which has been imported into this country to the extent of about 50,000 tons a-year, at a cost of over £6 per ton, not for the manufacture of sulphuric acid—which is now almost entirely made from iron pyrites—but for the various other uses for which sulphur is required. If the application of this method of recovering sulphur from soda waste were carried out to its full extent at the alkali works of this country, they would, therefore, be able to furnish a quantity of sulphur equal to that now imported from Sicily, not only with profit to the manufacturers, but with the advantage of preventing one of the most obnoxious forms of pollution to which the rivers of manufacturing districts are subject, while the product of the operation would itself have a money value amounting to about £300,000 a-year. The fact that the recovery of sulphur from alkali waste has so long been an object unsuccessfully pursued, together with the results now obtained, should afford encouragement for the persevering prosecution of attempts to utilise other kinds of waste or refuse materials which hitherto have either been neglected or have refused to yield whatever they contain of value in such a manner, and at such a cost, as to be worth extraction.—I am, &c., BEN. H. PAUL.

8, Gray's-inn-square, February 3rd, 1869.

## MEETINGS FOR THE ENSUING WEEK.

MON.....Society of Arts, 8. Cantor Lecture. Mr. S. A. Hart, R.A., "On Painting."
Social Science Assoc., 8. Mr. R. W. Cooke Taylor, "On a Project for opening the Civil Service to Women."
R. Geographical, 8½.
Medical, 8.
Victoria Inst., 8.
London Inst., 6.

TUES ...Royal Inst., 3. Mr. Westmacott, "On Fine Art."
Civil Engineers, 8. 1. Discussion, "The Mauritius Railways: Midland Line." 2. Professor Ansted, "On the Lagoons and Marshes of certain parts of the Shores of the Mediterranean."
Photographic, 8. Annual General Meeting.
Ethnological, 8. 1. "On Ceremonies accompanying Childbirth in Australia and New Zealand." Communicated by Dr. Hooker. 2. Mr. Hodder M. Westropp, "On Cromlechs and Megalithic Monuments."

WED ...Society of Arts, 8. Mr. G. C. T. Bartley, "On the Training and Education of Pauper Children."
Geological, 8. 1. Mr. E. Hull, "On a Ridge of lower Carboniferous Rocks crossing the Plain of Cheshire." 2. Rev. T. Wiltshire, "On the Red Chalk of Hunstanton." 3. Mr. W. Boyd Dawkins, "On the British Postglacial Mammalia."
Graphic, 8.
Microscopical, 8. Annual Meeting.
R. Literary Fund, 3.
Archæological Assoc., 8.

THUR ...Royal, 8½.
Antiquaries, 8½.
Zoological, 8½.
London Inst., 6.
Royal Society Club, 6.
Mathematical, 8.
Royal Inst., 3. Dr. M. Foster, "On the Involuntary Movements of Animals."
Society of Fine Arts, 8. First Musical Evening—Haydn, Mozart, and Beethoven. Conductor, Mr. Alfred Gilbert.

FRI .....Astronomical, 3. Annual Meeting.
Royal Inst., 8. Col. Drummond Jervois, "On the Coast Defences of England."
Royal United Service Inst., 3. Major C. Adams, "The Italian Campaign of 1866."

SAT .....Royal Inst., 3. Prof. Odling, "Hydrogen and its Analogues."
R. Botanic, 3¾.

# Patents.

*From Commissioners of Patents' Journal, January 29.*

GRANTS OF PROVISIONAL PROTECTION.

Alum, production of sulphate of potash for the manufacture of—130—P. Spence.
Armour, defensive—2885—T. Berney.
Artificial busts—156—J. D. Thomas.
Bell and clock chimes, mechanism for—180—W. Gillett & C. Bland.
Boots and shoes—146—W. Thomas.
Boots and shoes, &c., machinery for cleaning—167—S. G. Archibald.
Brooches, &c.—3885—L. A. W. Lund and E. Axmann.
Carding machines, &c.—184—P. C. Evans and H. J. H. King.
Cartridge cases—166—W. T. Eley.
Casks, &c.—141—J. H. Johnson.
Casks, &c., cleansing—122—J. Steel.
Chronographs, &c., keyless and stop work employed in—109—R. Watson and B. Dangerfield.
Churns—108—W. McDonnell.
Closets and urinals—154—N. Voice.
Coal, &c., getting—127—W. Tijou and W. Whieldon.
Collars and comforters combined—3901—L. J. Paine.
Cooking apparatus—142—H. A. Silver.
Cotton machinery, &c., couplings of rollers for—145—W. and S. Bottomley.
Door and window fasteners—129—W. H. Brookes.
Fabrics, manufacturing looped—147—J. B. Whitehall.
Fabrics, &c., mosaic textile and tesselated—152—W. Pidding.
Fire-arms, breech-loading—119—T. Birkett and H. Scott.
Fire-arms, breech-loading—128—A. Sehet.
Floor dogs or flooring cramps—170—W. and J. Pain.
Furnaces, moveable grates for—116—J. H. Kitson and J. Kirby.
Gas, &c.—186—H. A. Bonneville.
Gas meters, &c.—162—G. Brown.
Grain-cleaning mills—190—D. Spooner.
Gun barrels, cleaning—125—H. Fowkes.
Guns, breech-loading—176—C. E. Brooman.
Hackling machines—169—G. Lowry.
Horse-shoe nails, &c.—160—J. W. Price.
Hydraulic lifts—3927—J. W. Wilson.
Iron and steel—3911—D. S. Price.
Iron and steel—139—J. Jeavons and W. Waplington.
Iron and steel, converting vessels used in manufacturing—124—J. T. Smith.
Life buoys, &c.—110—J. R. Hodgson.
Looms—153—W. H. Platt.
Looms—155—C. Catlow.
Lubricators—3877—T. R. Shaw.
Meal and flour, dressing—158—R. H. Clarke.
Meat, salting and preserving—98—C. J. Günther.
Metal articles, moulding—151—M. Henry.
Metals, &c., cutting—3879—R. Wilson.
Millstones, dressing, &c.—111—T. Mortlock.
Oil, manufacturing—134—A. H. A. Durant.
Oils, &c., presses for expressing—117—T. Cook and J. Watson.
Paper-making machinery—138—R. Craig.
Peat, drying, &c.—29—J. J. Hays.
Piles, apparatus for driving—171—H. W. Hammond.
Punches—132—E. Craddock.
Railway breaks—65—M. Wilkin and J. Clark.
Railway level crossing gates, &c.—121—C. H. Lea.
Railway reading lamps, pocket—112—E. P. North.
Railway switch apparatus, &c.—172—J. Armstrong.
Railways—113—H. Vavasseur and C. M. Wade.
Railways, connecting the ends of rails in constructing—136—J. T. Bintley.
Reaping and mowing machinery—114—A. V. Newton.
Reaping and mowing machines—131—T. Howcroft and A. McGregor.
Refrigerators—178—J. Siddeley and F. N. Mackay.
Rheumatism, &c., instrument to be used in the treatment of—173—C. Baunscheidt.
Sand distributors—182—E. Burton.
Saw-hardening furnaces, &c.—64—J. Rodgers.
Saws, sharpening and setting—3891—J. H. Johnson.
Scales and weighing machines—165—H. and J. Parnall.
Scarfs, &c., fastenings for—194—A. M. Clark.
Screw nuts, bolts, &c.—159—G. R. Postlethwaite.
Shawls, &c.—150—W. R. Lake.
Ships' skylights—168—M. Burke.
Signalling apparatus—140—J. G. Johnson.
Spoons—135—T. A. Warrington.
Steam pumps—115—W. E. Newton.
Step-ladders—123—A. P. Chance.
Sugar—164—A. M. Clark.
Sulphate of ammonia—148—F. Braby.
Surgical trusses—192—J. C. L. Camel.
Valves—107—G. D. Kittoe and P. Brotherhood.
Velocipedes—94—C. E. Brooman.
Velocipedes and manumotive carriages—137—S. Russell.
Vessels, propelling—143—J. Bourne.
Vessels, propelling—174—N. D. Spartali.
Water, purifying and storing—188—F. Lipscombe.
Whist, &c., apparatus for scoring at—133—M. Boyce.
Window blinds, rollers and furniture for—126—D. P. Wright.
Wood, reducing to fibres, &c.—3727—C. Farrar.
Wool, &c., preparing and combing—157—P. Oldfield.

INVENTIONS WITH COMPLETE SPECIFICATIONS FILED.

Artificial marble—198—F. Walton.
Centrifugal machines—235—H. W. and R. Lafferty.
Composition for the manufacture of various useful or ornamental articles—222—J. M. Merrick, jun.
Ensor net or lace—207—F. R. Ensor.

PATENTS SEALED.

2399. T. C. Fidler.
2400. C. D. Fox.
2401. W. T. Royle.
2402. F. A. Leigh.
2403. J. Ratcliffe.
2404. A. G. Day.
2405. J. F. Lackersteen.
2413. H. Moritz and J. Reinach.
2414. H. Moritz and J. Reinach.
2422. J. A. McKean.
2424. M. Wilkins and J. Clark.
2432. L. C. Bailey.
2458. M. Benson.
2501. J. Brown.
2502. A. M. Clark.
2543. C. Evotte.
2556. A. M. Clark.
2660. W. M. Jackson and R. Garsides.
3438. J. Howard and E. T. Bousfield.
3698. A. C. Sterry, F. Lambe, and J. Fordred.
3759. H. A. Bonneville.

*From Commissioners of Patents' Journal, February 2.*

PATENTS SEALED.

2343. L. Wray.
2439. W. Spence.
2444. B. J. B Mills.
2450. C. G. Johnson.
2455. W. Millard.
2457. E. Edwards.
2464. W. and E. M. Hann.
2467. W. M. Moore.
2469. C. J. Curtis and A. Fiddes.
2473. N. Salamon.
2480. S. Gardner.
2489. F. Walton.
2503. J. Salmon.
2532. R. Saunders.
2570. C. J., W., A., & F. Simpson.
2659. T. Wrigley.
3033. B. E. R. Newlands.
3036. R. Heilmann and P. Hart.
3804. H. A. Bonneville.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

258. J. M. A. Montclar.
286. J. Robertson.
402. R. W. Armstrong.
430. J. Tomlinson.
301. C. Delafield.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

293. J. L. Norton.
223. G. H. and E. Morgan.
283. D. Joy.

# Registered Designs.

4994—Jan. 13—Nosing for stair-treads—F. Smith, Priory, Dudley.
4995—Jan. 21—Velocipede—Lloyd and Co., Birmingham.
4996—Jan. 25—Match-box—Bell and Black, Bow-lane, Cheapside.